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Original Research Article

Mean platelet volume and red blood cell distribution width coefficient of variation as predictors of prognosis in pneumonia in children

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ABSTRACT

Background: Community acquired pneumonia (CAP) is a major global health concern for children, causing numerous hospitalizations and death. Community acquired pneumonia is a major cause of under-five mortality in children. Identifying reliable prognostic markers is crucial. Mean platelet volume (MPV) and red cell distribution width co-efficient of variation (RDW-CV) are accessible and cost-effective options for assessment of prognosis in pneumonia. This study investigates MPV and RDW-CV as prognostic markers in children with community acquired pneumonia.
Methods: This prospective observational study includes 80 children aged 1-16 years diagnosed with pneumonia upon initial examination and admitted to hospital. Community acquired Pneumonia diagnosis was based on clinical symptoms, physical examination and/or radiological findings. Pneumonia severity was assessed using the Clinical Respiratory Score (CRS), categorizing patients into mild, moderate, severe groups. MPV and RDW-CV were compared among these groups.
Results: Across the sample of 80 children, RDW-CV and MPV values did not demonstrate statistically significant differences when compared by sex, age group, ICU requirement or hospital stay duration. For most comparisons, p-values exceeded 0.05, indicating that variations in these indices are likely due to random fluctuations rather than true biological differences.
Conclusions: Certain trends (higher RDW-CV and MPV in intense severity groups, elevated MPV in pleural effusion and significant ROC for MPV) are biologically plausible in the context of systemic inflammation. MPV appears to be a more reliable marker than RDW-CV in this dataset. RDW-CV did not demonstrate meaningful prognostic value. The findings reinforce that MPV may serve as a supportive, accessible biomarker for predicting more severe pneumonia in children, whereas RDW-CV requires larger sample evaluation to confirm its utility.

Keywords: Community acquired pneumonia, Mean platelet volume, Red cell distribution width

INTRODUCTION

CAP represents a substantial global health challenge according for a significant number of pediatric hospitalizations and standing as a leading cause of mortality among children.[1,2] In 2019 pneumonia was responsible for 14% of all deaths of children under 5 years but 22% of all deaths in children aged 1-5 years world-wide 16.4 million hospital admissions annually. CAP manifests as an acute infection affecting the lung parenchyma.[3] diagnosis typically relies on clinical symptoms, radiological findings especially in non-hospitalized or recently admitted individuals.[4] The severity spectrum of pneumonia ranging from mild to severe cases.[5] Pediatric CAP admission progress to severe illness, necessitating pediatric intensive care unit admission. Severe cases require advanced interventions, including both invasive and non-invasive mechanical support, aimed at reducing mortality rates.

Diagnosing CAP in children is challenging due to limited clinical data, including atypical imaging results and complex clinical indicators. Hence there is a need to identify reliable biomarkers to reduce mortality rate and

to asses prognosis accurately. Several markers are widely used for diagnosis, treatment and follow up of CAP such as C-reactive protein (CRP) and procalcitonin. CURB -65 and pneumonia severity index (PSI) scores are used for assessing the severity of pneumonia.[6]

Red cell distribution width is the standard deviation in red blood cell size divided by the mean corpuscular volume.it is included in the complete blood count panel with normal range of 11.5-14.5%. Recently RDW is being evaluated as prognostic marker for mortality in critically-ill patients.[7,8] Multiple inflammatory factors such as chemokines, cytokines and coagulation factors are secreted by platelets which increase in size when they are activated. Mean platelet volume 9 (MPV) is a reflection of platelet size, which has been shown to correlate the platelet function and activation.

A higher MPV value is indicative of increased platelet activity and thus more intense inflammation.[10] Changes in MPV have been studied in several chronic inflammatory diseases.[11-13] however to the best of our knowledge such changes have not been studied extensively with CAP. The aim of this study was to investigate whether RDW-CV and MPV values are affected by the inflammatory response in childhood CAP.

METHODS

Study design and participants

We conducted a prospective observational study on children aged 2months to 15 years who were diagnosed with CAP at the initial examination and were subsequently admitted to ESIC medical college and hospital pediatric unit Kalaburagi. between May-October 2025. Sample size was calculated using the formula n=Za/2 sigma/E, Za/2 is 1.96, sigma -0.28 E is 6%. The minimum sample size calculated to be 80.

Data included variables like demographics, vital parameters, oxygen support, complete blood count, duration of hospital stays, clinical respiratory score. CBC including RDW-CV and MPV were performed by automatic blood analyzer. RDW-CV and MPV values were recorded at the time of admission. All parents or caregivers received a detailed explanation of the study methods and their importance. written informed consent was obtained prior to participation, ensuring confidentiality and compliance with ethical guidelines approved by the Ethics committee of ESIC medical college and hospital Kalaburagi.

Exclusion criteria

Children with primary and secondary immunodeficiency diseases, receiving immunosuppressive treatments exceeding 20 mg daily of prednisolone or equivalent for 2 weeks or other immunosuppressive drugs Additionally, individuals with leucopenia, neutropenia or history of severe nutritional anemia and other type of anemias. Exclusion also encompasses lung abscess, chronic neurological diseases, congenital heart diseases, chronic lung diseases.

Diagnostic criteria

In the study CAP diagnosis was done on the basis of clinical manifestations including fever, cough, cold, hurried/ difficulty in breathing, pleuritic chest pain, combined with physical examination findings of tachypnea, tachycardia, increased respiratory effort, retractions, cyanosis and auscultation findings. Radiographic criteria consistent with CAP encompassed bilateral interstitial and bronchial infiltration or lobar involvement. indicators for hospitalization included toxic appearance, dehydration, moderate to severe respiratory distress, need for supplemental oxygen, failure to respond to outpatient treatment. The severity of CAP was measured using the clinical respiratory score which is based on the indicators mentioned in Table 1.

Severity classification

Patients were classified into three severity groups based on total scores<3 mild, 4-7 moderate, severe 8-12 indicates severe respiratory distress.

Laboratory procedures

On admission a minimum of 1 ml blood sample was collected for CBC analysis Samples were processed in the laboratory of ESIC medical college and hospital Kalaburagi. Normal ranges for MPV and RDW-CV were established according to the provided specifications. MPV and RDW-CV values were compared across severity groups.

Statistical analysis

Descriptive statistics, independent-sample t-tests and one-way ANOVA were used to compare MPV and RDW-CV across demographic and clinical variables, while ROC curve analysis assessed the diagnostic performance of these haematological indices. p value<0.05 considered as statistically significant.

RESULTS

This study evaluated the prognostic utility of Mean Platelet Volume (MPV) and Red Cell Distribution Width Coefficient of Variation (RDW-CV) among children diagnosed with pneumonia. Descriptive statistics, independent-sample t-tests and one-way ANOVA were used to compare MPV and RDW-CV across demographic and clinical variables, while ROC curve analysis assessed the diagnostic performance of these haematological indices. The findings from this analysis are discussed in relation to the reference study by Kiani et al.

Interpretation of descriptive and comparative statistics

Across the sample of 80 children, RDW-CV and MPV values did not demonstrate statistically significant differences when compared by sex, age group, ICU requirement or hospital stay duration. For most comparisons, p-values exceeded 0.05, indicating that variations in these indices are likely due to random fluctuations rather than true biological differences.

Sex

RDW-CV (p=0.6799) and MPV (p=0.7786) showed no significant difference between males and females.

Age

Children <5 years and ≥5 years had comparable RDW-CV (p=0.117) and MPV (p=0.330) values.

ICU admission

Neither RDW-CV (p=0.359) nor MPV (p=0.497) differed significantly between ICU and non-ICU groups.

Hospital stays

One-way ANOVA showed no significant variation in RDW-CV (p=0.787) or MPV (p=0.604) across the three duration groups (1–5, 6–10, 11–15 days).

These findings differ from Kiani et al who reported significantly elevated RDW-CV and MPV in children with severe CAP, in those hospitalized for >10 days and in ICU-admitted cases. The discrepancy may originate from differences in sample size (80 vs. 150 participants), case severity spectrum or pneumonia aetiology.

Clinical severity and disease complications

Although RDW-CV was higher numerically in intense CRS category, the difference remained statistically non-significant (p=0.329). MPV approached significance for CRS severity (p=0.0507), suggesting a trend toward higher platelet activation in more intense clinical presentation.

A notable observation was the significant elevation of MPV in children with pleural effusion (p=0.028). This mirrors the findings of Kiani et al who demonstrated significantly increased MPV and RDW-CV in children with pleural effusion. Platelet activation in inflammatory states may explain this pattern.

For overall disease severity classification (mild, moderate, intense), neither RDW-CV (p=0.628) nor MPV (p=0.173) showed significant associations. The non-significant results may be partly due to very small subgroup sizes, particularly for the moderate category (n=2).

ROC curve analysis for prognostic accuracy

The ROC analysis provided further insight into the discriminative ability of RDW-CV and MPV for predicting intense disease severity.

RDW-CV

AUC=0.575, p=0.333, 95% CI=0.426–0.725.

These values indicate poor discrimination and non-significant predictive value. This contrasts with Kiani et al, (2024), who found RDW-CV to be a highly accurate marker (AUC=0.973).

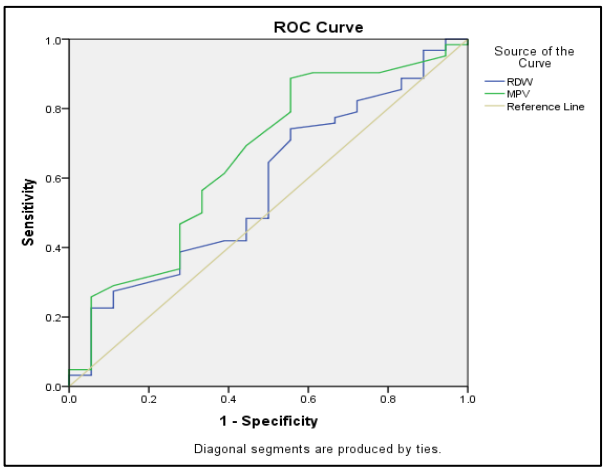

Figure 1: ROC of MPV and RDW-CV .

MPV

AUC=0.658, p=0.042, 95% CI=0.510–0.807.

MPV demonstrated fair discriminative ability, achieving statistical significance. While lower than the AUC reported by Kiani et al (0.845), these results still support MPV as a better prognostic indicator than RDW-CV in this cohort. The lower AUC values compared to the reference study likely reflect sample distribution differences, restricted severity variation and fewer complication cases in the present dataset.

Comparison with reference findings

Kiani et al concluded that both RDW-CV and MPV rise significantly in severe CAP and are strong prognostic markers, with RDW-CV outperforming MPV. In contrast, the present study observed. Non-significant RDW-CV differences across clinical categories, MPV performing better than RDW-CV (significant AUC for MPV, non-significant for RDW-CV). Significant MPV elevation in pleural effusion, supporting previous evidence.

Lower predictive accuracy overall. The divergence may arise from smaller sample size (N=80) leading to reduced

statistical power, differences in pneumonia severity distribution. Potential variation in laboratory methodologies. Fewer cases of complications like severe CAP and effusion.

Overall interpretation

Despite limited statistical significance across variables, certain trends (higher RDW-CV and MPV in intense severity groups, elevated MPV in pleural effusion and significant ROC for MPV) are biologically plausible in the context of systemic inflammation. MPV appears to be a more reliable marker than RDW-CV in this dataset. RDW-CV did not demonstrate meaningful prognostic value. The findings reinforce that MPV may serve as a supportive, accessible biomarker for predicting more severe pneumonia in children, whereas RDW-CV requires larger sample evaluation to confirm its utility.

Table 1: Clinical respiratory score severity classification.

Parameters	Score 0	Score 1	Score 2
Respiratory rate in 1 min	Age 1-5 years:<30	Age 1-5 years:30-40	Age 1-5 years:>40
	Age >5 years:<20	Age >5 years:20-30	Age >5 years >30
Auscultation	Equal air entry, Ronchi, crackles	Decreased air entry, severe Ronchi, crepitations	Diminished or absent breath sounds
Use of accessory muscles	Minimal to no use of accessory muscles	Severe intercostal and subcostal retractions, nasal flaring	Severe intercostal and subcostal retractions, nasal flaring
Mental status	normal	lethargic	lethargic
Room air spo2	>95%	<90%	<90%
Color	Normal	Cyanotic, dusky	Cyanotic, dusky

Table 2: RDW-CV and MPV levels across various demographic and clinical parameters.

Samples		RDW-CV				MPV			
n=80	**Variables**	**Count N (%)**	**Mean±SD**	**Statistic value**	**P value**	**Count N (%)**	**Mean±SD**	**Statistic value**	**P value**
Sex	Male	49 (61.25)	16.64±3.02	0.41448	0.6799	49 (61.25)	9.54±0.89	0.28218	0.778611
	Female	31 (38.75)	16.92±2.94			31 (38.75)	9.59±0.73		
Age (in years)	<5	59 (73.75)	17.06±2.96	1.61	0.117	59 (73.75)	9.50±0.80		
	>=5	21 (26.25)	15.87±2.91			21 (26.25)	9.72±0.89	0.9882	0.330446
ICU	Yes	30 (37.5)	16.37±2.64	0.9229	0.3592	30 (37.5)	9.47±0.92	0.6831	0.4975
	No	50 (62.5)	16.97±3.16			50 (62.5)	9.61±0.77		
Pleural effusion	Yes	02 (2.5)	17.15±3.041	0.1856	0.8832	02(2.5)	10.1±0.14	3.9778	0.0284*
	No	78 (97.5)	16.75±2.98			78 (97.5)	9.56±0.83		
Severity CRS.2level	Non-intense	62 (77.5)	16.91±3.04	0.9923	0.329	62 (77.5)	9.66±0.82	2.0419	0.0507
	Intense	18 (22.5)	16.17±2.75			18 (22.5)	9.22±0.79		
Hospital period (in days)	1-5	17 (21.25)	16.31±3.31			17 (21.25)	9.39±0.60		
	6-10	56 (70)	16.84±2.87	0.239752	0.787408	56 (70)	9.59±0.91	0.5067	0.6045
	11-15	07 (8.75)	17.04±3.33			07 (8.75)	9.7±0.62		
Disease severity	Mild	61 (76.25)	16.89±3.06			61 (76.25)	9.67±0.82		
	Moderate	2 (2.5)	15.15±4.31	0.467276	0.628472	2 (2.5)	8.8±0.28	1.707598	0.172546
	Intense	17 (21.25)	16.41±2.63			17 (21.25)	9.26±0.80		

Note: *indicates statistically significant difference at p<0.05. Independent-sample t-test and one-way ANOVA were used for comparison.

Table 3: Diagnostic accuracy table of RDW and MPV.

Test result variable(s)	Area under the curve	Asymptotic 95% confidence interval	P value
RDW	0.575	0.426-0.725	0.333
MPV	0.658	0.510-0.807	0.042*

*Indicates statistically significant at p<0.05.

DISCUSSION

Our study results suggested that elevated levels of MPV correlate with an increased risk of severe CAP and extended hospitalization in children. Due to wide spread availability and cost-effectiveness, MPV could serve as objective marker to aid in clinical assessment. The majority of studies exploring the association between elevated RDW-CV and MPV levels and pneumonia severity have reported consistent results. some studies have reported these markers individually. Qi et al, identified RDW-CV as an independent predictor of poor prognosis in children with severe pneumonia without assessing MPV.[14]

Some studies have investigated the relationship between platelet count and CAP. Kazrani et al reported an association between pleural effusion and thrombocytosis.[15] Golcuk and colleagues identified average platelet volume levels as valuable predictors of mortality and disease severity in CAP patients.[16] A limited numbers of studies including our study have done simultaneous evaluation of both RDW-CV and MPV as predictors of prognosis in CAP, representing a strength of the study. Farghly et al reported that increased MPV upon hospitalization for CAP was associated with more severe clinical features and higher mortality rates.[17] Consistent with these findings our study observed that elevated MPV levels in children with severe pneumonia, prolonged hospitalization and pleural effusion. Importantly in our study did not report any fatalities.

Sachdev et al found that high RDW-CV levels at admission can predict mortality in PICU and persistently raised RDW-CV value was associated with prolonged PICU stay. In the study there was no significant association between raised RDW-CV and duration of hospital stay. Sachdev et al study includes a short duration of study and small sample size, lack of segregated data as per disease profile and not statistically adjusting other risk factors of mortality were other limitations of the study. In the study found same limitations.

Karadag-Oncel et al found that patients with severe disease that required hospitalization were found to have significantly higher MPV values. Comparing with our study elevated MPV values in severe case. These findings suggests that MPV serve as promising new biomarker and prognostic indicators particularly in children with pneumonia, aiding in determining prognosis which is essential for appropriate disease management.

The increase in MPV in this study reflects an inflammatory state that induces platelet activation and subsequent release of larger platelet into circulation. inflammatory cytokines such as IL-1 and IL-6 can stimulate megakaryocytes to produce larger more reactive platelets which are characterized by an increased MPV. In context of CAP this increase in MPV might reflect the body's response to both infection and systemic inflammation it triggers which exacerbate the clinical severity by promoting microvascular complications. The findings suggests that the increase in MPV are not merely passive markers but may actively contribute to pathophysiology of CAP. Our findings suggested MPV may be a useful predictor for diagnosed CAP but not in disease severity.

Application findings

Understanding the factors that influences the prognosis of community acquired pneumonia particularly in children can guide the pediatricians in making well-formed treatment decision.

Limitations

Patients with severe nutritional anemia were excluded based on medical history and a definitive diagnosis based on laboratory criteria was not attainable. And small sample size.

CONCLUSION

The study findings suggestive of elevated levels of MPV and RDW-CV are associated with severe CAP in hospitalised children. This marker can effectively assist in assessing the prognosis of CAP.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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