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Original Article

Predictors of Prolonged Hospitalization in Pediatric Respiratory Syncytial Virus Infections

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ABSTRACT

Objective: Respiratory syncytial virus (RSV) is a leading cause of lower respiratory tract infections (LRTIs) in infants and young children. This study evaluated clinical and laboratory factors associated with prolonged hospitalization in pediatric RSV infection.

Methods: This retrospective study included children under 18 years of age who were hospitalized with LRTI and had confirmed RSV infection at Aydın Adnan Menderes University Hospital between 2023 and 2025. Demographic, clinical, and laboratory data were collected from hospital records. Patients were divided into two groups according to length of stay (LOS): ≤2 days and >2 days. Multivariate logistic regression analysis was performed using the backward stepwise method.

Results: A total of 185 RSV-infected children were analyzed. The median age was 2 months, and 51.9% were male. Patients with LOS >2 days had significantly higher rates of pediatric intensive care (PICU) admission, non-invasive ventilation, mechanical ventilation, and secondary bacterial infections. Laboratory findings in the prolonged-stay group showed higher lymphocyte counts and blood urea nitrogen (BUN) levels but lower mean platelet volume (MPV) levels. No mortality was observed. In the multivariate logistic regression analysis, PICU stay was associated with an approximately 12-fold increased risk of hospitalization lasting longer than 2 days.

Conclusion: Hospitalization longer than 2 days was associated with a more severe clinical course. In the multivariate logistic regression analysis, PICU stay was the main factor associated with hospitalization lasting longer than 2 days. Lymphocyte count, MPV, and BUN may provide supportive clinical information; however, their independent prognostic value remains uncertain.

Keywords: Respiratory syncytial virus, prolonged hospitalization, respiratory support, mean platelet volume

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INTRODUCTION

Respiratory syncytial virus (RSV) is among the most common etiologic agents of bronchiolitis and pneumonia, particularly in infants and older adults.[1] Lower respiratory tract infections (LRTIs) are a major cause of morbidity and mortality in children under 5 years of age, and RSV is one of the leading pathogens in this age group.[2,3] In temperate climates, RSV typically causes annual epidemics during autumn and winter, whereas in tropical regions, circulation often increases during the rainy season, and cases may occur year-round.[4,5] Globally, it was estimated that in 2019, RSV-associated acute LRTI occurred in 33.0 million children aged 0-60 months; these episodes resulted in 3.6 million hospitalizations, 26,300 in- hospital deaths, and a total of 101,400 deaths attributable to RSV.[6] In Türkiye, studies in children aged ≤2 years have shown high annual hospitalization incidences for LRTIs and bronchiolitis, with a substantial disease burden and higher RSV positivity clusters specifically in the 0-3 months age group.[7] Accordingly, RSV remains an important respiratory pathogen in both national and global clinical practice.

Severe RSV infection may present with hypoxemia and bronchiolitis-associated respiratory failure, particularly in young infants and children with significant comorbidities;

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some cases require intensive care and invasive mechanical ventilation. A nationwide cohort study in Denmark reported that mechanical ventilation was required in 14.3 per 1000 RSV hospitalizations, primarily due to bronchiolitis-related respiratory failure in young infants and those with comorbidities, while extra-pulmonary complications were more prevalent among children without classic risk factors.[8]

In RSV infection, routine laboratory tests are not diagnostic; they are primarily used to support the clinical picture, monitor disease severity, and guide management when co-infection is suspected.

Reverse transcription polymerase chain reaction (RT-PCR) is the gold standard for diagnosis.[9] Regarding blood parameters, some studies have reported differences in C-reactive protein (CRP) and systemic inflammatory markers in RSV-positive cases; however, they are useful as adjuncts to clinical assessment rather than for confirming RSV infection.[10] In severe RSV bronchiolitis, hyponatremia associated with increased antidiuretic hormone (ADH) secretion/syndrome of inappropriate ADH and aspartate aminotransferase (AST)/alanine aminotransf (ALT) elevations may be observed.[11,12]

This study aimed to describe the clinico-laboratory characteristics of RSV-positive children and identify factors associated with clinical outcomes, specifically length of hospital stay and disease severity.

METHODS

This retrospective observational study identified 985 pediatric patients who were followed in the pediatric infectious diseases ward and/or the pediatric intensive care unit (PICU) for acute LRTI and tested for RSV between January 1, 2022, and December 31, 2025, via the Aydın Adnan Menderes University Hospital electronic database. Patients aged <18 years who were hospitalized for acute LRTI with confirmed RSV positivity in a respiratory specimen were included.

Exclusion criteria were: suspected nosocomial RSV infection (symptom onset ≥48-72 hours after admission), conditions markedly affecting laboratory analyses (e.g., active malignancy, chemotherapy, severe immunosuppression, advanced chronic kidney or liver disease), and missing baseline laboratory or primary outcome data.

All data were obtained from the Aydın Adnan Menderes University Hospital information system. Recorded variables included demographics (age, sex), clinical outcomes (length of hospital and PICU stay, need for non-invasive and invasive ventilation, secondary bacterial infections), and laboratory parameters [white blood cell count (WBC), neutrophils, lymphocytes, hemoglobin, platelets, mean platelet volume (MPV), Na, blood urea nitrogen (BUN), creatinine, AST, ALT, gamma-glutamyl transferase (GGT), albumin, and CRP]. The CRP/albumin ratio was calculated for the same time point.

RSV was detected using multiplex real-time RT-PCR on nasopharyngeal swabs or aspirates as part of routine clinical practice. Patients with two or more viral detections on the respiratory panel were excluded to avoid difficulties in interpretation. Secondary bacterial infection was defined as a clinically suspected bacterial infection recorded during the hospitalization period and supported by microbiological evidence and/or compatible radiological and laboratory findings. Bacterial detection by PCR was considered clinically significant only when accompanied by compatible clinical findings such as persistent or recurrent fever, increased inflammatory markers, radiological evidence of pneumonia, positive blood culture, or an antibiotic treatment decision by the attending physician. Because of the retrospective design, the exact timing of secondary bacterial infection in relation to admission could not be consistently determined in all cases. Therefore, secondary bacterial infection was not included in the multivariable model as a baseline predictor.

To identify factors associated with prolonged hospitalization, the study population was dichotomized according to length of stay (LOS) as ≤2 days and >2 days. Because the median LOS of the cohort was 2 days, this cutoff was selected to identify patients hospitalized for longer than the median. This median-based cutoff is consistent with previous pediatric RSV/acute lower respiratory infection research, in which longer LOS was defined as >2 days (the median).[13]

The study protocol was approved by the Aydın Adnan Menderes University Ethics Committee on April 14, 2026, with protocol number 2026/133.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 22 was used for statistical analyses (IBM SPSS Statistics for Windows, Version 22.0, NY, USA). Descriptive statistics were presented as number and percentage for normally distributed categorical data, while continuous variables were presented as median (25^{th}-75^{th} percentile) for non-normally distributed data. The normality of continuous variables was evaluated using the Kolmogorov-Smirnov test. Between-group comparisons were performed using the Mann-Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Statistical significance was defined as $p<0.05$. Multivariate logistic regression analysis was performed using the backward stepwise method to evaluate factors associated with hospitalization lasting longer than 2

days. PICU stay, non-invasive ventilation, mechanical ventilation, lymphocyte count at diagnosis, BUN, and MPV were included in the initial model. Odds ratios and 95% confidence intervals (CIs) were calculated for the variables retained in the final model.

RESULTS

A total of 185 (18.8%) patients were diagnosed with RSV via multiplex real-time RT-PCR. Of these, 123(66.5%) had a LOS of ≤2 days and 62 (33.5%) had a stay of >2 days (Table 1). The median age was 2 months [interquartile range (IQR): 2-7] in the ≤2-day group and 3 months (IQR: 2-6) in the >2-day group, with no significant difference (p=0.915). Male sex accounted for 54.5% (67/123) of the ≤2-day group and 46.8% (29/62) of the >2-day group (p=0.323).

The median LOS was 1 day (IQR: 1-2) in the ≤2-day group and 3 days (IQR: 3-7) in the >2-day group (p<0.001). PICU admission was required for 14.1% (26/185) of all patients, differing significantly between groups: 4.1% (5/123) in the ≤2-day group versus 33.9% (21/62) in the >2-day group (p<0.001). Non-invasive ventilation was required in 7.6% (14/185) of patients and was more frequent in the >2-day group (19.4% vs. 1.6%, p<0.001). Invasive mechanical ventilation was required in 2.2% (4/185) of patients and occurred exclusively in the >2-day group (6.5% vs. 0%, p=0.012). Secondary bacterial infections were detected in 33.5% (62/185) of the cohort, with a significant difference between groups (p<0.001).

Complete blood count parameters (WBC, neutrophils, hemoglobin, and platelets) were comparable between groups, with the exception of lymphocytes and MPV. The median MPV was significantly higher in the ≤2-day group [10 (9-11) vs. 9 (9-10) fL, p=0.039]. Conversely, the median lymphocyte count was lower in the ≤2-day group [2349 (1314-3842) vs. 2891 (2000-4600), p=0.011]. Other laboratory parameters, including sodium, CRP, albumin, CRP/albumin ratio, AST, ALT, GGT, and creatinine, did not differ significantly between groups, except for BUN. Median

Table 1. Characteristics of the patients according to the duration of hospitalization

	Hospitalization ≤2 days n=123 (66.5%)	Hospitalization >2 days n=62 (33.5%)	p
Age, months, mean (25-75 percentile)	2 (2-7)	3 (2-6)	0.915
Male gender, n (%)	67 (54.5)	29 (46.8)	0.323
PICU stay, n (%)	5 (4.1)	21 (33.9)	**<0.001**
Non-invasive ventilation, n (%)	2 (1.6)	12 (19.4)	**<0.001**
Mechanical ventilation, n (%)	0 (0)	4 (6.5)	**0.012**
Secondary bacterial infections, n (%)	0 (0)	62 (33.5)	**<0.001**
Hyponatremia (serum Na <135 Meq/mL), n (%)	16 (13)	6 (9.7)	0.509
WBC, /mm^3, mean (25-75 percentile)	9536 (8353-11734)	10239 (8656-12000)	0.128
Neutrophils, /mm^3, mean (25-75 percentile)	5942 (4000-7245)	5967 (4200-6738)	0.578
Lymphocytes, /mm^3, mean (25-75 percentile)	2349 (1314-3842)	2891 (2000-4600)	**0.011**
Hemoglobin, gr/dL, mean (25-75 percentile)	11 (10-12)	11 (10-12)	0.556
Platelets, /mm^3, mean (25-75 percentile)	432000 (378000-481000)	395000 (365000-473000)	0.538
MPV, fL, mean (25-75 percentile)	10 (9-11)	9 (9-10)	**0.039**
Na, gr/dL, mean (25-75 percentile)	136 (136-137)	136 (136-138)	0.097
CRP, gr/dL, mean (25-75 percentile)	4 (1-8)	5 (1-12)	0.515
Albumin, gr/dL, mean (25-75 percentile)	39 (36-41)	38 (37-40)	0.849
AST, U/L, mean (25-75 percentile)	35 (27-46)	38 (28-50)	0.524
ALT, U/L, mean (25-75 percentile)	28 (22-34)	27.5 (22-36)	0.769
GGT, U/L, mean (25-75 percentile)	28 (21-39)	27.5 (20-41)	0.823
BUN, mg/dL, mean (25-75 percentile)	4 (4-8)	7 (4-9)	**0.023**
Creatinine, mg/dL, mean (25-75 percentile)	1 (1-1)	1 (1-1)	0.314
CRP/Albumin, mean (25-75 percentile)	0.10 (0.02-0.20)	0.12 (0.02-0.46)	0.551

PICU: Pediatric intensive care unit, Na: Sodium, WBC: White blood cell count, MPV: Mean platelet volume, CRP: C-reactive protein, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, GGT: Gamma-glutamyl transferase, BUN: Blood urea nitrogen, U/L: Units per liter

BUN was 4 mg/dL (4-8) in the ≤2-day group compared to 7 mg/dL (4-9) in the >2-day group (p=0.023).

In a logistic regression analysis for hospitalization longer than 2 days, performed using the backward stepwise method with PICU stay, non-invasive ventilation, mechanical ventilation, lymphocyte count at diagnosis, BUN, and MPV as candidate variables, PICU stay increased the risk by 12-fold in the final significant model (95% CI: 4.2-34.3) (Table 2).

DISCUSSION

In the present cohort, prolonged hospitalization due to RSV infection was associated with a more severe and clinically demanding disease course, suggesting a bidirectional relationship. Patients hospitalized for more than two days exhibited significantly higher rates of both non-invasive and invasive mechanical ventilation and a higher frequency of secondary bacterial infections. In addition, they had higher lymphocyte counts, lower MPV, and higher BUN.

The close relationship between longer LOS and greater respiratory support requirements has been demonstrated in previous studies. In the prospective National BRICK study, invasive mechanical ventilation rate was 61.1% among infants admitted to the PICU for RSV, indicating the high burden of respiratory support in this population.[14] In a Hungarian study of hospitalized children with severe acute respiratory infection, the median LOS was 5 days, and multivariable logistic regression showed that receipt of mechanical ventilation or oxygen support increased the likelihood of hospitalization lasting >4 days , pneumonia, and RSV etiology by 3.23-, 3.65-, and 3.25-fold, respectively.[15] Similarly, in another study of RSV-associated LRTI cases, "severe RSV" was defined as any of the following: hospitalization for >7 days, ICU admission, non-invasive or invasive ventilation, or in-hospital mortality; 40.16% of cases were reported to meet this definition.[16] In our study, hospitalization lasting longer than 2 days was used as a median-based outcome measure to evaluate factors associated with a more severe clinical course among children with RSV infection.

The association between secondary bacterial infection and prolonged hospitalization is clinically plausible. Because the timing of secondary bacterial infection could not be consistently determined, this association should be interpreted as a disease-course relationship rather than as evidence of baseline prediction. Recent studies have similarly shown that bacterial infections accompanying RSV can increase both disease severity and length of hospitalization. In a multicenter prospective surveillance study in Portugal, potentially pathogenic bacteria were detected in 20.4% of hospitalized cases of RSV; in this group, PICU admission was more frequent, hospital stays were longer, and the risk of severe disease was reported to be increased 13.2-fold.[17] Across different series, bacterial coinfection was identified in 32.4% of children with RSV pneumonia and 47.3% of hospitalized RSV-positive children. Pneumococcus was the most prevalent pathogen, and children with bacterial coinfection had longer hospital stays and a greater need for PICU care.[18] LOS remained one of the independent predictors of bacterial coinfection.[19] Diaz-Diaz et al.[20] defined a prolonged stay as lasting longer than 3 days. They described nasopharyngeal coexistence of *Streptococcus pneumoniae* and/or *Haemophilus influenzae* as being associated with a more severe clinical course, particularly increasing the likelihood of requiring oxygen and of prolonged hospitalization.

In this study, prolonged hospitalization due to RSV infection was associated with higher lymphocyte counts. In contrast, the study by Matera et al.[21] involving 1,297 infants hospitalized for bronchiolitis reported that RSV positivity was more frequent in the lowest lymphocyte group, which was associated with higher clinical severity scores, greater oxygen requirements, longer hospital stays, and more frequent PICU unit admissions. In another study that evaluated 325 children with RSV-associated bronchiolitis, each unit increase in lymphocyte percentage was associated with a lower likelihood of severe disease, similar to our study.[22] The lymphocyte difference observed in our study is not merely an isolated laboratory variable but may represent an immunological response associated with a more severe clinical course and longer hospitalization.

We observed lower MPV levels in patients with prolonged hospitalization, which may reflect platelet consumption or an altered platelet response during a more severe and

Table 2. Multivariate logistic regression analysis of risk factors for prolonged hospitalization

Independent variable	Odds ratio	95% CI	p
PICU admission	12.047	4.236-34.263	<0.001
MPV	0.746	0.527-1.056	0.098

Backward stepwise logistic regression was performed. Nagelkerke R^2 =0.219; Cox and snell R^2 =0.158; Hosmer-Lemeshow $\chi^2(4)=6.712$
PICU: Pediatric intensive care unit, MPV: Mean platelet volume, CI: Confidence interval

sustained inflammatory process. However, MPV does not show a consistent trend across RTIs. While Doğan et al.[23] reported increased MPV associated with bronchiolitis severity in 179 cases, Feketea et al.[24] found lower MPV in non-influenza viral respiratory infections compared to influenza and healthy controls. To date, no study has specifically evaluated MPV in RSV. Although our findings align with some data from viral RTIs, further studies are needed before MPV can be considered an RSV-specific marker or a reliable indicator of disease severity.

We found higher BUN levels in the prolonged-stay group, which likely reflect reduced oral intake, dehydration, and increased catabolic stress rather than intrinsic renal dysfunction, since creatinine levels did not differ between groups. This is indirectly supported by the bronchiolitis literature, which identifies dehydration and poor feeding—conditions often accompanied by clinically significant fluid-electrolyte disturbances—as predictors of escalated care. However, specific evidence supporting BUN as an independent severity marker for RSV remains limited, and recent predictive studies have failed to identify urea as an independent risk factor. Consequently, elevated BUN should be regarded as a supportive clinical finding rather than a definitive prognostic marker.[25-27]

Apart from the variables identified as significant, most clinical and laboratory parameters did not differ between groups defined by length of hospital stay. Patients with shorter and prolonged hospitalizations were similar with respect to age, sex, hyponatremia, total WBC and neutrophil counts, hemoglobin, platelet counts, sodium, CRP, albumin, AST, ALT, GGT, creatinine, and the CRP/albumin ratio. These findings suggest that LOS-related differences were limited to selected clinical severity indicators and specific laboratory parameters, while the majority of baseline characteristics remained comparable between groups.

Although this study provides clinically relevant data on factors associated with prolonged RSV hospitalization, notably respiratory support requirements, secondary bacterial infections, and specific laboratory abnormalities, it has several limitations. First, the single-center retrospective design is inherently subject to selection bias and has limited generalizability. Important clinical confounders such as prematurity, congenital heart disease, chronic lung disease, immunodeficiency, and other underlying medical conditions could not be consistently retrieved from the retrospective database. The absence of these variables may have resulted in residual confounding and may limit the causal interpretation of the observed associations. Clinical decisions, such as PICU transfers and initiation of ventilation, were based on physicians' judgment rather than a standardized protocol, potentially introducing practice-based variability. Second, dichotomizing LOS (≤2 vs. >2 days) simplified the analysis but may have reduced data granularity and obscured dose-response relationships. Third, the lack of consistent data on ventilation duration and dynamic severity markers limited the ability to more comprehensively characterize the disease burden. Finally, potentially repeated admissions of the same patients may have influenced the frequencies of clinical outcomes.

CONCLUSION

In this pediatric RSV cohort, hospitalization longer than 2 days was associated with a more severe clinical course, including PICU admission and greater need for respiratory support. In the multivariate logistic regression analysis, PICU stay emerged as the main factor associated with hospitalization lasting longer than 2 days. Secondary bacterial infections were more frequent in the prolonged-stay group; however, because their timing could not be consistently determined, this finding should be interpreted cautiously as part of the clinical disease course rather than as a baseline predictor. Selected laboratory parameters, including lymphocyte count, MPV, and BUN, may provide supportive clinical information; however, their independent prognostic value remains uncertain. Prospective studies including major clinical confounders and validated LOS thresholds are needed to confirm these findings.

Ethics

Ethics Committee Approval: The study protocol was approved by the Aydın Adnan Menderes University Ethics Committee on April 14, 2026, with protocol number 2026/133.

Informed Consent: This retrospective study was conducted using data obtained from existing hospital records.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.A., S.S.K., Concept: A.A., S.S.K., Design: A.A., S.S.K., Data Collection or Processing: A.A., M.K., S.S.K., Analysis or Interpretation: A.A., M.K., S.S.K., Literature Search: A.A., M.K., S.S.K., Writing: A.A., M.K., S.S.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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