RESEARCH PAPER

Admission D-dimer and Clinical Severity in Community-Acquired Pneumonia: A Prospective Observational Study

Dr Shrilakshmi N[1*], *Dr Deepu C C[2], Dr Vijayalakshmi[3]*

[1]Junior Resident, Department of Respiratory Medicine, Adhichunchangiri Institute of Medical Sciences, Adhichunchangiri University, B G Nagara - 571448

[2]Professor and Head of Department, Department of Respiratory Medicine, Adhichunchangiri Institute of Medical Sciences, Adhichunchangiri University, B G Nagara - 571448

[3]Assistant Professor, Department of Respiratory Medicine, Adhichunchangiri Institute of Medical Sciences, Adhichunchangiri University, B G Nagara – 571448

ABSTRACT

Introduction: Community-acquired pneumonia (CAP) remains a frequent cause of adult hospitalisation and short-term mortality. Clinical severity scores are useful at admission, yet they may not fully reflect the systemic inflammatory and coagulative burden of severe infection. D-dimer, a fibrin degradation product, may offer a simple adjunctive marker for early risk stratification.

Aim: To evaluate the association of admission D-dimer levels with CURB-65 score, Pneumonia Severity Index (PSI), ATS/IDSA severity classification, and clinical outcomes in adults admitted with CAP.

Materials and Methods: This hospital-based prospective observational study was conducted in the Department of Respiratory Medicine, Adichunchanagiri Hospital and Research Centre, B.G. Nagara, Karnataka, India, from March 2024 to August 2025. A total of 130 adults with clinically, radiologically, and laboratory-confirmed CAP were analysed. Admission D-dimer levels were compared across CURB-65, PSI, ATS/IDSA severity strata, primary outcome categories, and secondary outcomes. Normality was assessed using the Shapiro-Wilk test. Quantitative variables were expressed as mean±standard deviation and categorical variables as frequency and percentage. Group-wise comparisons were performed using appropriate parametric or non-parametric tests according to distribution, and receiver operating characteristic (ROC) curve analysis was performed for non-invasive ventilation (NIV), intubation, and mortality prediction. IBM SPSS Statistics for Windows, version 31.0 was used. A p-value <0.05 was considered statistically significant.

Results: The mean admission D-dimer level was 1.425±1.35905 mg/L. D-dimer increased significantly with rising CURB-65 score: 0.94±0.99 mg/L at score 1, 2.21±1.70 mg/L at score 2, and 2.27±1.13 mg/L at score 3 ($p<0.001$). It also increased across PSI classes, from 0.72±0.67 mg/L in Class I to 2.21±1.01 mg/L in Class V ($p<0.001$). Severe CAP by ATS/IDSA criteria was associated with higher D-dimer than non-severe CAP (2.20±1.49 mg/L vs 0.91±0.98 mg/L; $p<0.001$). Higher levels were observed among patients requiring NIV, intubation, mechanical ventilation with vasopressor support, prolonged hospital stay, and among those who died. ROC analysis showed AUC values of 0.793 for intubation, 0.807 for mortality, and 0.660 for NIV requirement.

Conclusion: Admission D-dimer was significantly associated with established severity scores and adverse outcomes in adults with CAP. Used with clinical scoring systems, it may help identify patients who require closer monitoring and timely escalation of care.

Keywords: Community-Acquired Pneumonia; Fibrin Fibrinogen Degradation Products; Severity of Illness Index; Mortality; Respiratory Insufficiency.

How to cite this article: Shrilakshmi N, Deepu CC, Vijayalakshmi. Admission D-dimer and Clinical Severity in Community-Acquired Pneumonia: A Prospective Observational Study. Int J Drug Deliv Technol. 2026;16(58s): 754-762. DOI: 10.25258/ijddt.16.58s.81

INTRODUCTION

Community-acquired pneumonia continues to be an important infectious cause of adult hospitalisation and death, and early recognition of severe disease remains central to adult CAP management [1]. In Indian tertiary-care hospitals, this burden is shaped by delayed presentation, background comorbidity, and uneven access to high-dependency care [2]. Recent Indian evidence has also emphasised the need for locally useful risk-stratification approaches, rather than reliance on imported thresholds alone [3].

Early severity assessment is therefore not a clerical exercise; it directly shapes triage. The Pneumonia Severity Index provides a broad mortality-oriented prognostic framework [4]. CURB-65 offers a more rapid bedside estimate and has been validated for use at presentation [5]. ATS/IDSA severity criteria are used when severe CAP and possible intensive-care need must be identified. These tools remain clinically useful, but they largely represent a

snapshot of patient characteristics and organ-level derangement. A biochemical marker that reflects the host response may add another layer of clinical information.

D-dimer is generated during fibrin degradation and is commonly interpreted as a marker of coagulation activation and fibrinolysis. Arslan et al. reported that D-dimer levels increased with CAP severity [6]. Snijders et al. found higher D-dimer levels in severe CAP and in clinical failure, although the marker was not positioned as a replacement for clinical scoring [7]. A later meta-analysis further supported the association between elevated D-dimer and mortality in CAP [8].

The wider biomarker literature also supports the principle that biochemical markers can complement clinical judgement in CAP. C-reactive protein has been reported as an independent severity marker [9], while serum albumin has shown prognostic value when combined with respiratory rate and severity scores [10]. Reviews of pneumonia biomarkers have similarly argued that single markers are most useful when interpreted within the broader clinical picture [11].

The usefulness of admission D-dimer across multiple clinical severity systems and outcome categories remains particularly relevant in Indian tertiary-care settings, where early recognition of deterioration can alter monitoring and escalation decisions. The primary objective of the present study was to evaluate the association of admission D-dimer with CURB-65 score, PSI class, and ATS/IDSA severity classification among adults admitted with CAP. The secondary objective was to assess its association with NIV requirement, intubation, prolonged hospital stay, and mortality. It was hypothesised that higher admission D-dimer levels would be associated with greater CAP severity and adverse clinical outcomes.

MATERIALS AND METHODS

Study design and setting

This hospital-based prospective observational study was conducted in the Department of Respiratory Medicine, Adichunchanagiri Hospital and Research Centre, B.G. Nagara, Mandya, Karnataka, India. The study period was 18 months, from March 2024 to August 2025.

STUDY POPULATION

Adult patients admitted to the ward or intensive care unit with community-acquired pneumonia were screened consecutively. Patients aged more than 18 years with clinically, radiologically, and laboratory-confirmed CAP who provided written informed consent were included. Patients unwilling to provide consent, patients with malignancy, bleeding disorders, thromboembolic disorders, and pregnant women were excluded.

SAMPLE SIZE

The sample size was calculated using the formula $n=Z1^2S^2/d^2$, with $Z1=1.9$ for 95% confidence, $S=81.9$, and absolute precision $(d)=15$. The minimum required sample size was 115. A total of 130 patients with complete admission D-dimer measurement, severity-score assessment, and in-hospital outcome documentation were included in the final analysis. No imputation was performed.

Data collection and variables

Demographic characteristics, clinical history, examination findings, and admission investigations were recorded using a structured proforma. The variables analysed in the present article included age, sex, CURB-65 score, PSI class, ATS/IDSA severity category, admission D-dimer level, primary outcome category, and secondary outcome category. D-dimer was measured at admission along with other relevant investigations. Pneumonia severity was assessed using CURB-65, PSI, and ATS/IDSA criteria. Primary outcome categories included improvement, escalation of antibiotics, escalation of antibiotics with NIV, mechanical ventilation with vasopressor support, and intubated mechanical ventilation. Secondary outcomes included discharge, death, and prolonged hospital stay. D-dimer levels were compared across severity strata and outcome groups to evaluate their association with clinical severity and adverse outcomes.

ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the Institutional Ethics Committee of Adichunchanagiri Institute of Medical Sciences, B.G. Nagara. The committee registration number documented in the IEC certificate was EC/NEW/INST/2023/KA/0382. Written informed consent was obtained before enrolment, and confidentiality was maintained throughout the study.

STATISTICAL ANALYSIS

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 31.0 (IBM Corp., Armonk, NY, USA). Normality of continuous variables was assessed using the Shapiro-Wilk test and visual inspection of histograms. Quantitative variables were expressed as mean±standard deviation, and categorical variables as frequency and percentage. For categorical comparisons, Chi-square test or Fisher's exact test was used where applicable. For comparisons of D-dimer across two-group and multi-category severity or outcome strata, appropriate parametric or non-parametric tests were applied according to data distribution. ROC curve analysis was used to assess the ability of D-dimer to predict NIV requirement, intubation, and mortality. All statistical tests were two-tailed, and $p<0.05$ was considered statistically significant.

Table/Fig 1: Participant flow diagram.

Flow chart depicts enrolment and final analytical sample. CAP: Community-acquired pneumonia.

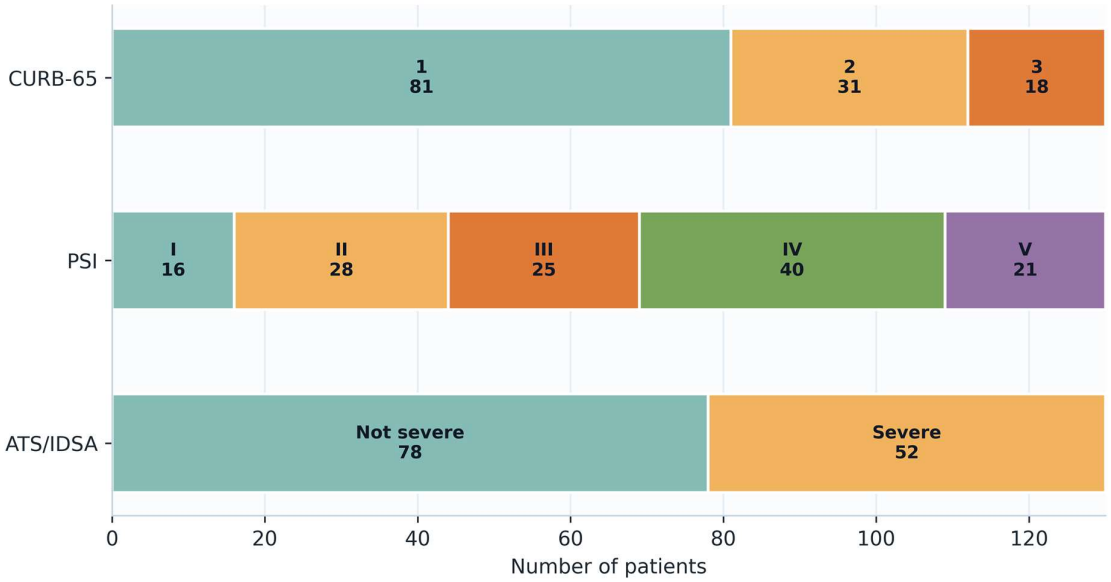
RESULTS

A total of 130 adults with CAP were included in the final analysis. The largest age group was 61-70 years, accounting for 41 patients (31.5%). There was a slight male predominance, with 69 men (53.1%) and 61 women (46.9%). Most patients had a CURB-65 score of 1, while nearly half were in PSI Class IV or V. Based on ATS/IDSA criteria, 52 patients (40.0%) were classified as severe CAP. The baseline profile is shown in Table/Fig 2, and the severity distribution is illustrated in Table/Fig 3.

Table/Fig 2: Baseline demographic and severity profile of the study cohort (n=130).

Variable	n	%
Age group (years)		
18-30	6	4.6
31-40	12	9.2
41-50	17	13.1
51-60	30	23.1
61-70	41	31.5
71-80	13	10.0
81-90	10	7.7
>90	1	0.8
Sex		
Male	69	53.1
Female	61	46.9
CURB-65 score		
1	81	62.3
2	31	23.8
3	18	13.8
PSI class		
I	16	12.3
II	28	21.5
III	25	19.2
IV	40	30.8
V	21	16.2
ATS/IDSA severity		
Not severe	78	60.0
Severe	52	40.0

ATS/IDSA: American Thoracic Society/Infectious Diseases Society of America; PSI: Pneumonia Severity Index.



Table/Fig 3: Distribution of patients across CURB-65, PSI, and ATS/IDSA severity categories.

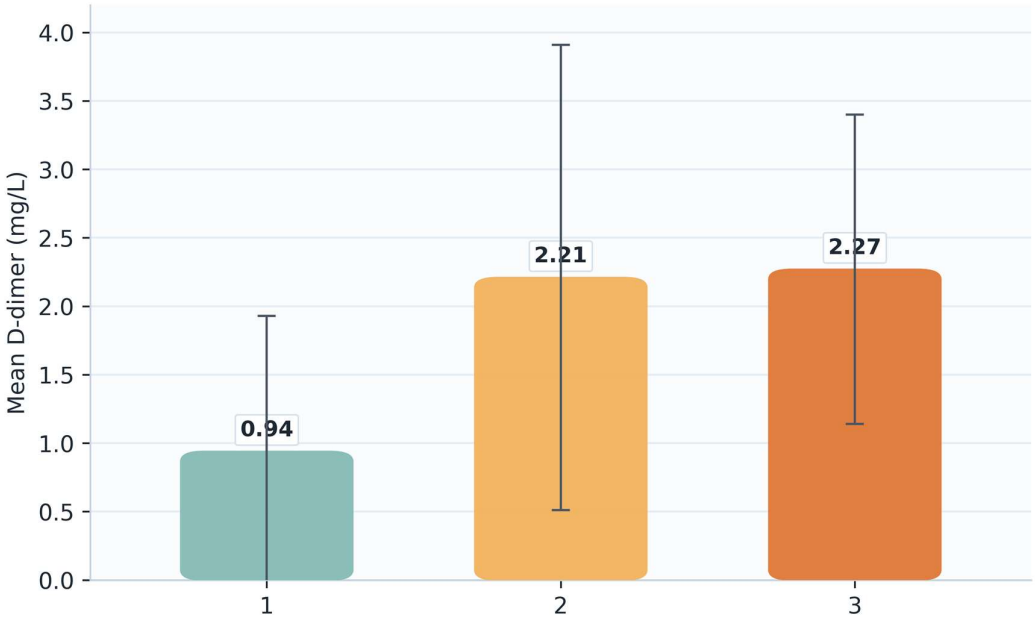
Segment labels show category and patient count. ATS/IDSA: American Thoracic Society/Infectious Diseases Society of America; CURB-65: Confusion, urea, respiratory rate, blood pressure and age ≥65 years; PSI: Pneumonia Severity Index.

The overall mean admission D-dimer level was 1.425±1.35905 mg/L. A consistent rise in D-dimer was observed across all severity systems. According to CURB-65, mean D-dimer increased from 0.94±0.99 mg/L at score 1 to 2.21±1.70 mg/L at score 2 and 2.27±1.13 mg/L at score 3 ($p<0.001$). Across PSI classes, D-dimer increased from 0.72±0.67 mg/L in Class I to 2.21±1.01 mg/L in Class V ($p<0.001$). Patients classified as severe by ATS/IDSA criteria had higher D-dimer levels than those with non-severe CAP (2.20±1.49 mg/L vs 0.91±0.98 mg/L; $p<0.001$). These findings are presented in Table/Fig 4 to Table/Fig 7.

Table/Fig 4: Admission D-dimer levels according to severity classification systems.

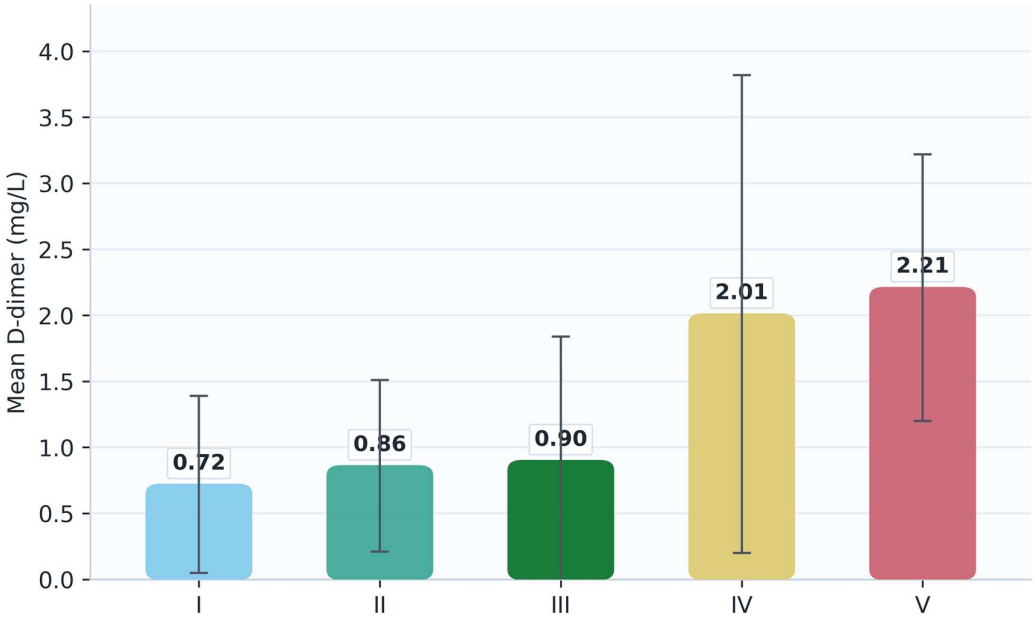
Severity category	Mean D-dimer (mg/L)	SD	p-value
CURB-65 score 1	0.94	0.99	<0.001
CURB-65 score 2	2.21	1.70	
CURB-65 score 3	2.27	1.13	
PSI Class I	0.72	0.67	<0.001
PSI Class II	0.86	0.65	
PSI Class III	0.90	0.94	
PSI Class IV	2.01	1.81	
PSI Class V	2.21	1.01	
ATS/IDSA Not severe	0.91	0.98	<0.001
ATS/IDSA Severe	2.20	1.49	

ATS/IDSA: American Thoracic Society/Infectious Diseases Society of America; PSI: Pneumonia Severity Index.



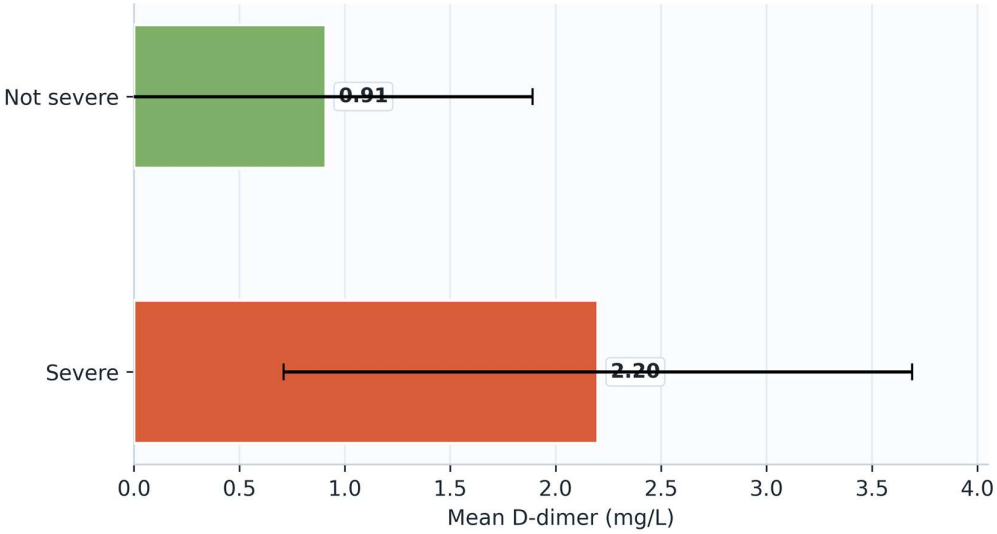
Table/Fig 5: Mean admission D-dimer according to CURB-65 score.

Bars represent mean values and error bars represent standard deviation. CURB-65: Confusion, urea, respiratory rate, blood pressure and age ≥65 years.



Table/Fig 6: Mean admission D-dimer according to Pneumonia Severity Index class.

Bars represent mean values and error bars represent standard deviation. PSI: Pneumonia Severity Index.



Table/Fig 7: Mean admission D-dimer according to ATS/IDSA severity classification.

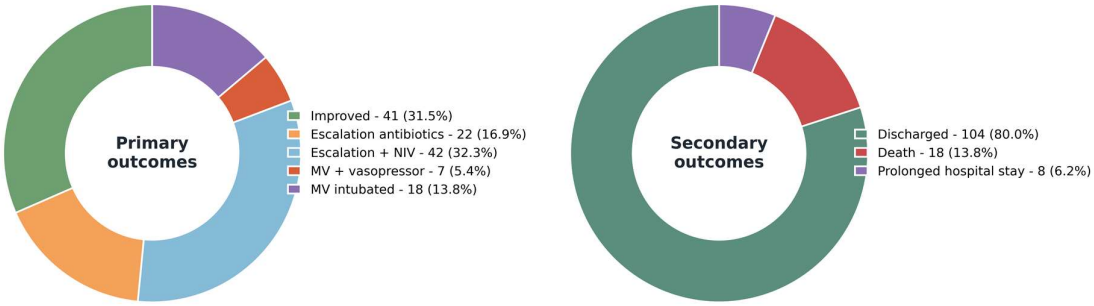
Bars represent mean values and error bars represent standard deviation. ATS/IDSA: American Thoracic Society/Infectious Diseases Society of America.

D-dimer also varied significantly across clinical outcomes. Patients who improved without escalation had the lowest mean D-dimer level (0.60±0.43 mg/L). Higher values were observed among those requiring escalation of antibiotics, escalation with NIV, mechanical ventilation with vasopressor support, and intubated mechanical ventilation. In secondary outcome analysis, D-dimer was higher among patients who died and among those with prolonged hospital stay than among discharged patients. Outcome-wise D-dimer levels are shown in Table/Fig 8, and outcome distribution is shown in Table/Fig 9.

Table/Fig 8: Admission D-dimer levels according to clinical outcomes.

Outcome category	n	Mean D-dimer (mg/L)	SD	p-value
Primary outcome				
Improved	41	0.60	0.43	<0.001
Escalation of antibiotics	22	1.41	1.81	
Escalation + NIV	42	1.77	1.46	
MV + vasopressor	7	2.24	1.38	
MV intubated	18	2.21	0.91	
Secondary outcome				
Discharged	104	1.13	1.13	<0.001
Death	18	2.51	1.51	
Prolonged hospital stay	8	2.88	1.73	

MV: Mechanical ventilation; NIV: Non-invasive ventilation.



Table/Fig 9: Distribution of primary and secondary outcomes in the study cohort.

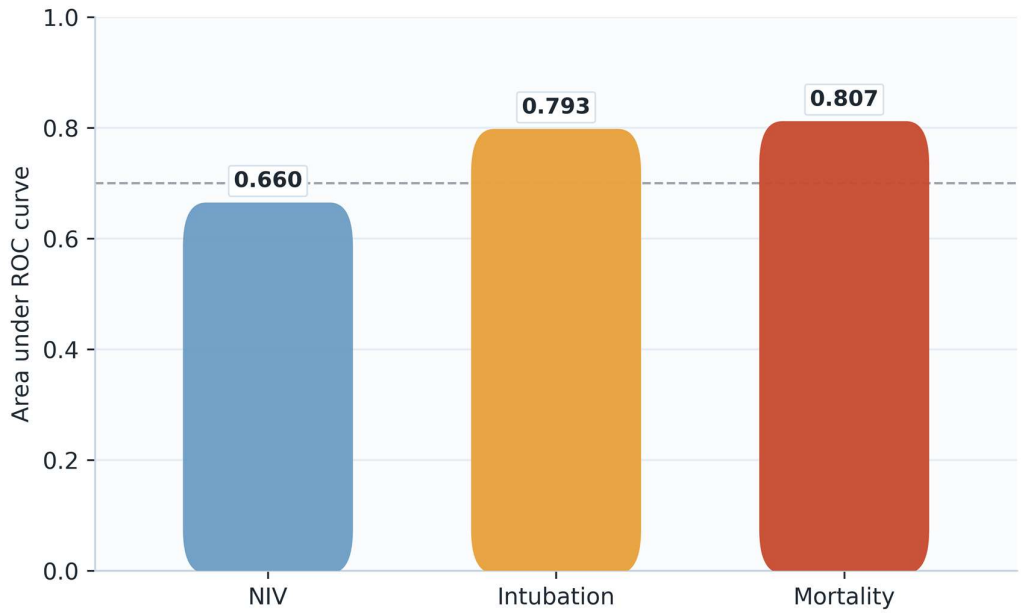
Legend values indicate number and percentage of patients.

On ROC analysis, D-dimer showed the strongest discrimination for mortality and intubation. The AUC was 0.807 for mortality, 0.793 for intubation, and 0.660 for NIV requirement. The optimal cut-off for intubation was 1.0 mg/L, with 85.0% sensitivity and 74.0% specificity. The mortality cut-off was 0.93 mg/L, with 83.3% sensitivity and 76.8% specificity. ROC findings are summarised in Table/Fig 10 and Table/Fig 11.

Table/Fig 10: ROC analysis of admission D-dimer for adverse clinical outcomes.

Predicted outcome	AUC	95% CI	Optimal cut-off	Sensitivity (%)	Specificity (%)	p-value
NIV requirement	0.660	0.564-0.755	≥1.065 mg/L	69.0	65.9	0.003
Intubation requirement	0.793	0.701-0.885	1.0 mg/L	85.0	74.0	<0.001
Mortality	0.807	0.721-0.893	0.93 mg/L	83.3	76.8	<0.001

AUC: Area under curve; CI: Confidence interval; NIV: Non-invasive ventilation; ROC: Receiver operating characteristic.



Table/Fig 11: Area under ROC curve values for D-dimer in predicting NIV, intubation, and mortality.

Higher values indicate stronger discriminatory performance.

DISCUSSION

The present study demonstrated a consistent association between admission D-dimer and CAP severity. D-dimer increased across CURB-65 scores, PSI classes, and ATS/IDSA severity groups. This convergence is important because the three scoring systems assess severity differently: CURB-65 is practical at bedside, PSI offers broader prognostic stratification, and ATS/IDSA criteria identify severe CAP requiring intensive monitoring. Reviews of CAP biomarkers have similarly emphasised that laboratory markers are most useful when they supplement, rather than replace, clinical severity assessment [12]. The parallel rise in D-dimer in the present cohort suggests that coagulation activation reflects a biologically meaningful dimension of illness severity.

The findings are biologically plausible. Severe pneumonia can trigger endothelial activation, fibrin turnover, cytokine-mediated coagulation, and immunothrombosis. Earlier D-dimer studies in CAP have reported higher levels in severe disease, clinical failure, and mortality. However, the present findings also reinforce the practical need to keep severity assessment clinically anchored, as definitions of severe CAP and the performance of different severity tools may vary across patient populations [13].

Outcome-wise analysis added further clinical relevance. Patients who improved had the lowest mean D-dimer level, whereas those requiring NIV, invasive ventilation, vasopressor-supported ventilation, or those who died had higher values. This pattern is consistent with the concept that respiratory deterioration in CAP is accompanied by systemic inflammatory and coagulative activation. It also sits well with the broader evidence that simple bedside scores can predict death in CAP and remain useful when rapid triage is required [14].

ROC analysis showed good discrimination for mortality and intubation, while performance for NIV requirement was moderate. This difference is understandable. Intubation and death are relatively definite markers of severe physiological decline, while NIV use may be influenced by clinician preference, local protocols, and timing of escalation. Pneumonia itself is a heterogeneous syndrome with variable host response and outcome trajectories, and biomarker interpretation should therefore remain integrated with clinical assessment [15].

The implications are particularly relevant for tertiary-care hospitals in India. Admission D-dimer is widely available, relatively inexpensive, and rapidly interpretable. When combined with CURB-65, PSI, and ATS/IDSA criteria, it may help refine triage, identify patients who require closer monitoring, and support earlier escalation of care. Still, D-dimer remains non-specific. It should be interpreted cautiously in patients with conditions that independently elevate D-dimer, such as thromboembolic disease, malignancy, pregnancy, or bleeding disorders. Such patients were excluded here, which strengthens internal validity but narrows direct generalisability.

LIMITATIONS

The study was conducted at a single centre, which may limit generalisability. Some outcome subgroups, especially mechanical ventilation with vasopressor support and prolonged hospital stay, had small numbers. This article focused specifically on D-dimer, although the broader clinical study also evaluated CRP and serum albumin. Serial D-dimer trends were not analysed, and microbiological stratification was not incorporated. As the design was observational, the findings should be interpreted as associations rather than causal effects.

CONCLUSION

Admission D-dimer levels were significantly associated with CURB-65 score, PSI class, ATS/IDSA severity classification, and adverse clinical outcomes in adults with community-acquired pneumonia. The marker showed the strongest discrimination for mortality and intubation requirement. When interpreted alongside established severity scores, admission D-dimer may support early risk stratification and timely escalation of care.

SOURCE OF FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

1. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K, et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019;200(7):e45-e67. doi:10.1164/rccm.201908-1581ST.

2. Gupta D, Agarwal R, Aggarwal AN, Singh N, Mishra N, Khilnani GC, et al. Guidelines for diagnosis and management of community- and hospital-acquired pneumonia in adults: Joint ICS/NCCP(I) recommendations. Lung India. 2012;29(Suppl 2):S27-S62. doi:10.4103/0970-2113.99248.

3. Vikhe VB, Faruqi AA, Patil RS, Reddy A, Khandol D. A systematic review of community-acquired pneumonia in Indian adults. Cureus. 2024;16(7):e63976. doi:10.7759/cureus.63976.

4. Fine MJ, Auble TE, Yealy DM, Hanusa BH, Weissfeld LA, Singer DE, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med. 1997;336(4):243-250. doi:10.1056/NEJM199701233360402.

5. Lim WS, van der Eerden MM, Laing R, Boersma WG, Karalus N, Town GI, et al. Defining community acquired pneumonia severity on presentation to hospital: An international derivation and validation study. Thorax. 2003;58(5):377-382. doi:10.1136/thorax.58.5.377.

6. Arslan S, Ugurlu S, Bulut G, Akkurt I. The association between plasma D-dimer levels and community-acquired pneumonia. Clinics (Sao Paulo). 2010;65(6):593-597. doi:10.1590/S1807-59322010000600006.

7. Snijders D, Schoorl M, Schoorl M, Bartels PC, van der Werf TS, Boersma WG. D-dimer levels in assessing severity and clinical outcome in patients with community-acquired pneumonia. A secondary analysis of a

randomised clinical trial. Eur J Intern Med. 2012;23(5):436-441. doi:10.1016/j.ejim.2012.01.010.
8. Yang C, Zeng HH, Huang J, Zhang QY, Lin K. Predictive roles of D-dimer for mortality of patients with community-acquired pneumonia: A systematic review and meta-analysis. J Bras Pneumol. 2021;47(6):e20210072. doi:10.36416/1806-3756/e20210072.
9. Chalmers JD, Singanayagam A, Hill AT. C-reactive protein is an independent predictor of severity in community-acquired pneumonia. Am J Med. 2008;121(3):219-225. doi:10.1016/j.amjmed.2007.10.033.
10. Zhao L, Bao J, Shang Y, Zhang Y, Yin L, Yu Y, et al. The prognostic value of serum albumin levels and respiratory rate for community-acquired pneumonia: A prospective, multi-center study. PLoS One. 2021;16(3):e0248002. doi:10.1371/journal.pone.0248002.
11. Karakioulaki M, Stolz D. Biomarkers in pneumonia - beyond procalcitonin. Int J Mol Sci. 2019;20(8):2004. doi:10.3390/ijms20082004.
12. Kruger S, Welte T. Biomarkers in community-acquired pneumonia. Expert Rev Respir Med. 2012;6(2):203-214. doi:10.1586/ers.12.6.
13. Buising KL, Thursky KA, Black JF, MacGregor L, Street AC, Kennedy MP, et al. A prospective comparison of severity scores for identifying patients with severe community acquired pneumonia: Reconsidering what is meant by severe pneumonia. Thorax. 2006;61(5):419-424. doi:10.1136/thx.2005.051326.
14. Bauer TT, Ewig S, Marre R, Suttorp N, Welte T. CRB-65 predicts death from community-acquired pneumonia. J Intern Med. 2006;260(1):93-101. doi:10.1111/j.1365-2796.2006.01657.x.
15. Torres A, Cilloniz C, Niederman MS, Menendez R, Chalmers JD, Wunderink RG, et al. Pneumonia. Nat Rev Dis Primers. 2021;7(1):25. doi:10.1038/s41572-021-00259-0.