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Original Article

Role of Monocyte Lymphocyte Ratio as a Predictor of Mortality in Patients with Acute Respiratory Distress Syndrome

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Abstract:

Background: *Early outcome prediction in Acute Respiratory Distress Syndrome is vital for better management. Existing tools like scores, imaging, and biomarkers have limitations, while Monocyte Lymphocyte Ratio offers a simpler, efficient alternative for predicting mortality more accurately.*

Aims: *To evaluate the association between monocyte lymphocyte ratio with mortality in patients with Acute Respiratory Distress Syndrome.*

Methods: *This cohort study was carried out in the Department of Critical Care Medicine, BIRDEM General Hospital, Dhaka, for 18-months following ethical approval. A total of 95 diagnosed ARDS cases were included who fulfilled the enrollment criteria. Along with clinical assessment sample for CBC was sent within 24 hours of diagnosis and documented the monocyte and lymphocyte counts. Patients were observed up to 28 days for mortality. Data were collected in separate record forms and analyzed by SPSS 22.*

Results: *The mean Monocyte Lymphocyte Ratio (MLR) was significantly higher in non-survivors (0.59±0.46) than survivors (0.37±0.12) ($p<0.05$). MLR differed significantly in patients with respiratory distress, hypotension, and fatigue. It increased with ARDS severity: severe (0.56±0.49), moderate (0.30±0.12), and mild (0.25±0.14), though intergroup difference wasn't significant ($p>0.05$). Only 35% survived at 28 days. A significant negative correlation existed between MLR and PaO_2/FiO_2 ($r = -0.314$, $p = 0.002$). ROC analysis showed MLR had better predictive accuracy (AUC = 0.69, cut-off 0.26) than NLR (AUC = 0.56, cut-off 10.0) for ARDS mortality.*

Conclusion: *Monocyte Lymphocyte Ratio can predict ARDS mortality and, being affordable and simple, is a practical tool for resource-limited settings like ours.*

Keywords: *Acute respiratory failure, Acute lung injury, Lymphocytes, Monocytes, Mortality, Prognostic.*

Introduction:

Acute Respiratory Distress Syndrome (ARDS) is a rapidly progressive and life-threatening condition characterized by widespread lung inflammation and hypoxemia. It commonly arises secondary to pneumonia, sepsis, or trauma and is a major contributor to ICU mortality, with reported death rates between 35% and 45%.[1] Accurate early prediction of mortality in ARDS is essential to optimize ventilation strategies, pharmacological treatment, and resource allocation, ultimately enhancing patient survival.[2] However, the heterogeneity in ARDS etiology complicates prognosis, and outcome prediction requires an integrated, multi-dimensional approach.[3]

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Traditional predictors of ARDS outcomes include clinical factors such as age, comorbid conditions, and the severity of the initiating illness.[4] Though valuable, these clinical indicators alone are insufficient to capture the complex progression of ARDS. A more accurate prognostic strategy involves the integration of clinical variables with physiological and biomarker-based data.[5] Physiologic measures like PaO_2/FiO_2 ratio are routinely used to gauge hypoxemia severity and are closely linked to mortality,[6] yet they primarily reflect respiratory dysfunction and not systemic inflammation.[7]

Mechanical ventilation parameters such as PEEP, tidal volume, and driving pressure offer important information about lung mechanics but fail to address systemic immunological involvement in ARDS.[8] This underlines the need for biomarkers that reflect inflammatory burden and immune dysregulation. Biomarkers like IL-6, IL-8, CRP, lactate, and leukocyte-based ratios (e.g., NLR, MLR) have emerged as potential predictors of ARDS severity.[9] Yet, the routine clinical utility of many of these markers is hindered by cost, complexity, and limited accessibility.[10-11]

The Monocyte-to-Lymphocyte Ratio (MLR) is a simple, inexpensive biomarker derived from routine complete blood counts. It reflects the balance between pro-inflammatory monocytes and immunoregulatory lymphocytes and has been

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associated with worse outcomes in critically ill patients, including those with ARDS.[12] Studies highlight its growing potential as a prognostic tool.[13-14] Unlike more complex cytokine panels, MLR is cost-effective and suitable for wide-scale implementation.

Integrating MLR into a multi-predictor model may enhance prognostic accuracy and facilitate personalized care in ARDS patients.[15] This study aims to assess the utility of MLR in predicting 28-day mortality and its role in guiding treatment strategies. The goal is to establish MLR as a low-cost, accessible prognostic tool to improve ARDS management outcomes.

Methods

This cohort study was conducted in the Department of Critical Care Medicine at BIRDEM General Hospital, Dhaka, Bangladesh- a 30-bed intensive care unit (ICU) equipped with modern medical technologies and staffed by trained intensivists and nurses offering multidisciplinary care. The study period spanned from October 2022 to March 2024. A convenience sampling technique was used to enroll patients admitted to the ICU who were diagnosed with ARDS according to the Berlin criteria. A total of 95 patients were included based on specific inclusion criteria, which were: age 18 years or older, a confirmed diagnosis of ARDS, availability of complete blood count (CBC) with differential within 24 hours of diagnosis, and provision of informed consent either by the patient or a legal guardian. Exclusion criteria included patients with hematologic malignancies (e.g., leukemia, lymphoma), those on immunosuppressive therapy or chemotherapy within the past six months, individuals with autoimmune disorders or chronic infections, those with incomplete blood test data for calculating MLR, and pregnant women.

After obtaining ethical clearance from the Institutional Review Board (IRB) of BIRDEM General Hospital, eligible participants were enrolled. Following enrolment, informed consent was obtained, and demographic and clinical information was recorded. Within 24 hours of ARDS diagnosis, 5 ml of venous blood was collected aseptically—3 ml for CBC and 2 ml for other investigations. Samples were immediately transferred to EDTA tubes and sent to the hospital laboratory for analysis. Additional laboratory, radiological, and imaging data—including chest X-ray and oxygenation indices (PaO_2/FiO_2)—were documented. The variables recorded included demographic data (age, sex), clinical factors (diabetes mellitus, hypertension, asthma/COPD), laboratory values (Hb%, ESR, monocyte count, lymphocyte count, neutrophil count, RBS, HbA1C), and radiographic findings. The primary outcome was 28-day mortality, categorized as "Yes" or "No." All data were recorded using a semi-structured questionnaire. Patients were monitored for 28 days, and their survival status was compared against their Monocyte-to-Lymphocyte Ratio (MLR) to explore its association with mortality.

Operational definitions

Acute Respiratory Distress syndrome (ARDS): A draft definition proposed 3 mutually exclusive categories of ARDS based on degree of hypoxemia: mild (200 mm Hg < PaO_2/FIO_2 ≤ 300 mm Hg), moderate (100 mm Hg < PaO_2/FIO_2 ≤ 200 mm Hg), and severe (PaO_2/FIO_2 ≤ 100 mm Hg) and 4 ancillary variables for severe ARDS: radiographic severity, respiratory system compliance (≤40 mL/cm H_2O), positive end-expiratory pressure (≥10 cm H_2O), and corrected expired volume per minute (≥10 L/min).[16]

MLR: Monocyte-to-lymphocyte ratio (MLR) is the absolute monocyte count divided by the absolute lymphocyte count and has been demonstrated to be a novel hematological and inflammatory parameter.[17] Normal value of monocyte: 2-8% of WBC. Normal value of lymphocyte: 20-40% of WBC

Statistical analysis:

Following data collection, the collected data was assessed for completeness, accuracy and consistency before analysis was commenced. Data analysis was carried out by using SPSS version 22 (IBM Corp., Armonk, NY). Independent t-test, ANOVA test and chi-square test were used to compare continuous and categorical variables, respectively. Kaplan-Meier survival curve was done to understand survival patterns and influencing factors. ROC analysis was also done to get a cut off with a suitable sensitivity and specificity. A level of $p< 0.05$ was considered statistically significant with 95% confidence interval.

RESULTS:

Table I: Association between MLR with demographic profile (N=95)

Demographic profile	Monocyte Lymphocyte Ratio Mean± SD	p value
Age (years)		
≤50 (n=21)	0.39±0.29	[a]0.101[ns]
51-60 (n=31)	0.49±0.52	
61-70 (n=25)	0.66±0.57	
>70 (n=18)	0.35±0.17	
Sex		
Male (n=39)	0.55±0.48	[b]0.290[ns]
Female (n=56)	0.45±0.43	

ns= not significant

[a]p value reached form ANOVA test

[b]p value reached form Independent t-test

Table I compares MLR across different age groups using ANOVA and between genders using an independent t-test, revealing no statistically significant differences in either analysis.

Table II: Association between MLR with clinical features (N=95)

Clinical features	Monocyte Lymphocyte Ratio Mean± SD	p value
Severe shortness of breath		
Yes (n=92)	0.50±0.46	0.371[ns]
No (n=3)	0.26±0.06	
Labored and unusual rapid breathing		
Yes (n=41)	0.62±0.47	0.018[s]
No (n=54)	0.40±0.42	
Low blood pressure		
Yes (n=40)	0.60±0.49	0.042[s]
No (n=55)	0.41±0.41	
Extreme tiredness		
Yes (n=60)	0.57±0.55	0.040[s]
No (n=35)	0.37±0.18	
Crackles on auscultation		
Yes (n=63)	0.60±0.54	0.076[ns]
No (n=32)	0.44±0.33	

s= significant
ns= not significant
p value reached form Independent t-test

Table II shows that the differences in mean Monocyte Lymphocyte Ratio (MLR) were statistically significant ($p < 0.05$) in relation to labored and unusually rapid breathing, low blood pressure, and extreme tiredness.

Table III: Association between MLR with Co-morbidity (N=95)

Co-morbidity	Monocyte Lymphocyte Ratio Mean± SD	p value
DM Status		
Yes (n=81)	0.51±0.47	0.189[ns]
No (n=14)	0.34±0.23	
HTN Status		
Yes (n=79)	0.52±0.49	0.198[ns]
No (n=16)	0.36±0.11	
Asthma/COPD Status		
Yes (n=60)	0.52±0.48	0.407[ns]
No (n=35)	0.44±0.40	

ns= not significant
p value reached form Independent t-test

Table III shows there is no statistically significant ($p>0.05$) association between MLR and diabetes mellitus, hypertension, or asthma/COPD, as determined by independent t-tests.

Table IV: Association between MLR with the severity of ARDS at the time of diagnosis (N=95)

Severity of ARDS PaO_2/FiO_2 ratio	Monocyte lymphocyte ratio n	Mean± SD	Range (min, max)	p value
Mild (200-300 mmHg)	13	0.25±0.14	0.09,0.53	
Moderate (100 to <200 mmHg)	11	0.30±0.12	0.09,0.53	0.031[s]
Severe (<100 mmHg)	71	0.56±0.49	0.10,2.25	

s= significant

p value reached form ANOVA test

Table IV presents the association between Monocyte Lymphocyte Ratio (MLR) and the severity of ARDS, classified based on PaO_2/FiO_2 ratios at the time of diagnosis. The analysis showed a statistically significant difference in mean MLR across the severity groups—mild, moderate, and severe ARDS—based on ANOVA results ($p = 0.031$).

Table V: Association between recovery and mortality with the severity of ARDS at the time of diagnosis (N=95)

Severity of ARDS	Survival		Non-surviva		p value
PaO2/FiO2 ratio	n	%	n	%	
Mild (200-300 mmHg)	13	13.7	0	0.0	[a]0.001[s]
Moderate (100-200 mmHg)	9	9.5	2	2.1	
Severe (<100 mmHg)	11	11.6	60	63.2	
Mean± SD	175.42±75.23		92.08±13.51		[b]0.001[s]

s= significant

[a]p value reached form Chi-square test

[b]p value reached form Independent t-test

Table V evaluates the relationship between ARDS severity, based on PaO_2/FiO_2 ratios, and patients' outcome (survival vs. non-survival). Statistically significant association was observed between ARDS severity categories and survival status, as determined by the Chi-square test ($p = 0.001$). Additionally, the mean PaO_2/FiO_2 ratio was significantly lower in non-survivors compared to survivors, based on independent t-test analysis ($p = 0.001$).

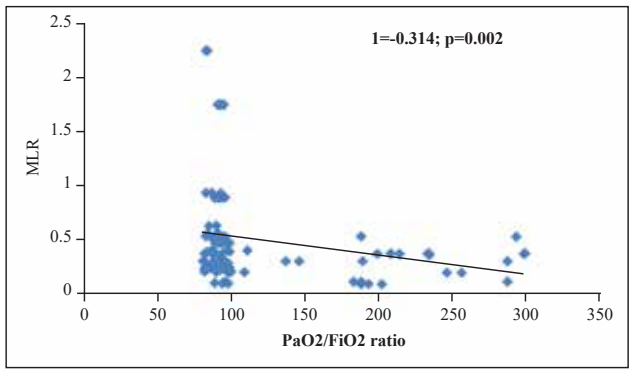

Figure 1: Scatter diagram showing a negative significant (r=-0.314; p=0.002) correlation found between MLR and PaO_2/FiO_2 ratio.

Table VI: Receiver operating characteristic (ROC) curve of PaO_2/FiO_2 ratio for prediction of acute respiratory distress syndrome

	Cut of value	Sensitivity	Specificity	AUC	P value	95% (CI) Lower bound	Upper bound
PaO_2/FiO_2 ratio	15.5	62.5	48.3	0.61	0.084	0.49	0.73

Table VI presents the AUC suggests limited discriminative ability, the association did not reach statistical significance (p = 0.084), with a 95% confidence interval ranging from 0.49 to 0.73.

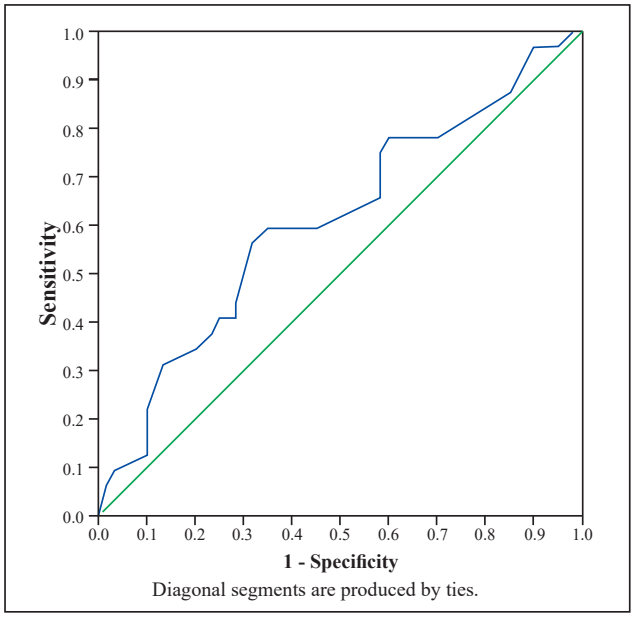

Figure 2: Receiver-operator characteristic (ROC) curve PaO_2/FiO_2 ratio for prediction of acute respiratory distress syndrome.

The above figure illustrates the Receiver Operating Characteristic (ROC) curve of the PaO_2/FiO_2 ratio and the area under the curve (AUC) falls within a 95% confidence interval of 0.49 to 0.73, and the statistical analysis yields a p-value of 0.084, indicating that the association between the PaO_2/FiO_2 ratio and ARDS does not reach statistical significance.

Table VII: Outcome of the study patients by demographic profile (N=95)

Demographic profile	Survival n	Survival %	Non-survival n	Non-survival %	p value
Age (years)					
≤50	4	4.2	17	17.9	
51-60	11	11.6	20	21.1	
61-70	10	10.5	15	15.8	
>70	8	8.4	10	10.5	
Mean±SD	60.37±16.6		62.42±10.57		[a]0.522[ns]
Ranged (min, max)	35,76		41,104		
Sex					
Male	12	12.5	27	28.4	[b]0.497[ns]
Female	21	22.1	35	36.7	

ns= not significant

[a]P value reached form Independent t-test

[b]P value reached form Chi-square test

Table VII assesses the association between patient outcomes (survival vs. non-survival) and demographic variables such as age and sex among ARDS patients. The mean age and gender difference of survivors and non-survivors showed no statistically significant difference by the independent t-test (p = 0.522) and Chi-square test (p = 0.497) respectively.

Table VIII: Outcome of the study patients by clinical features (N=95)

Clinical features	Survival n	Survival %	Non-survival n	Non-survival %	p value
Severe shortness of breath					
Yes	30	31.6	62	65.2	0.015[s]
No	3	3.2	0	0.0	
Labored and unusual rapid breathing					
Yes	11	11.6	30	31.6	0.158[ns]
No	22	23.2	32	33.7	
Low blood pressure					
Yes	15	15.8	25	26.3	0.629[ns]
No	18	18.9	37	38.9	
Extreme tiredness					
Yes	16	16.8	19	20.0	0.122[ns]
No	17	17.9	43	45.3	

Crackles on auscultation					
Yes	25	26.3	38	40.0	0.155[ns]
No	8	8.4	24	25.3	

s= significant

ns= not significant

p value reached form Chi-square test

Table VIII explores the association between clinical features and patient outcomes (survival vs. non-survival) in ARDS patients. Severe shortness of breath showed a statistically significant association with mortality (p = 0.015). However, other clinical features did not show significant associations with survival status.

Table IX: Outcome of the study patients by co-morbidity (N=95)

Co-morbidity	Survival n	Survival %	Non-survival n	Non-survival %	p value
DM					
Yes	30	31.6	51	53.7	0.257[ns]
No	3	3.2	11	11.6	
HTN					
Yes	27	28.4	52	54.7	0.799[ns]
No	6	6.3	10	10.5	
Asthma/COPD					
Yes	19	20.0	41	43.2	0.410[ns]
No	14	14.7	21	22.1	

ns= not significant

p value reached form Chi-square test

Table IX analyzes the relationship between co-morbid conditions and outcomes (survival vs. non-survival) in patients with ARDS and showed no statistically significant association.

Table X: Outcome of the study patients by laboratory findings (N=95)

Laboratory findings	Survival n=33 Mean± SD	Non-survival n=62 Mean± SD	p value
Hb (%)	9.88±1.77	10.54±1.75	0.084[ns]
Range (min, max)	6.8,14.9	7.6,14.9	
ESR (mm)	46.06±18.04	41.89±13.47	0.206[ns]
Range (min, max)	23,76	24,83	
Monocyte (%)	2.93±1.18	3.54±1.6	0.057[ns]
Range (min, max)	1.1,5.2	1,9	
Lymphocyte (%)	11.58±6.99	9.53±7.24	0.186[ns]
Range (min, max)	3.9,31.6	2,31.6	
Monocyte lymphocyte ratio	0.31±0.12	0.59±0.53	0.003[s]
Range (min, max)	0.09,0.53	0.1,2.25	
Median (interqurtial)	0.30 (0.19-0.37)	0.40 (0.23-0.89)	
Neutrophil Lymphocyte Ratio	9.79±5.79	14.05±9.26	0.009[s]
Range (min, max)	2.0,22.8	2.0,37.5	
Median (interqurtial)	8.50(6.98-12.43)	11.14(7.29-19.57)	
Neutrophil (%)	82.54±7.86	83.17±8.39	0.722[ns]
Range (min, max)	64,91.2	64,93.8	
RBS (mg/dl)	11.09±5.41	10.27±3.51	0.374[ns]
Range (min, max)	4,26	4,19	

s= significant

ns= not significant

p value reached form Independent t-test

Table X evaluates the association between various laboratory findings and patient outcomes (survival vs. non-survival) in ARDS patients. Among the variables analyzed, two laboratory markers demonstrated statistically significant associations with mortality: Monocyte Lymphocyte Ratio (MLR) (p = 0.003) and Neutrophil Lymphocyte Ratio (NLR) (p = 0.009). Other laboratory parameters did not show statistically significant associations with survival status.

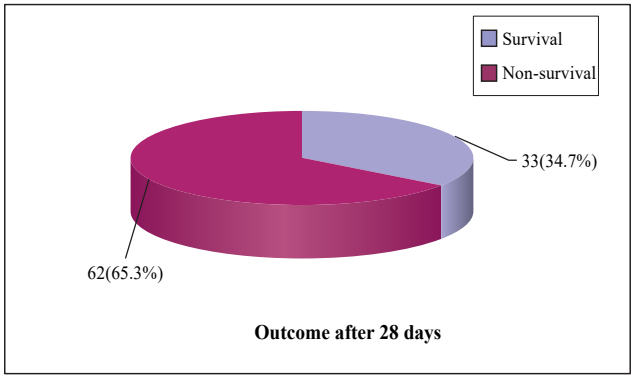

Figure 3: Pie chart showing more than one third 34.7% patients survived and 65.3% expired.

Table XI: Distribution of the non-survival patients according to hospital stay (n=62)

Days	Number	Percentage
0-7	5	8.1
8-14	9	14.5
15-21	17	27.4
22-28	31	50.0

A total of 62 patients expired, among them half (50.0%) of patients expired from 16-28 days, 17(27.4%) from 15-21 days, 9(14.5%) from 8-14 days and 5(8.1%) patients expired from 0-7 days.

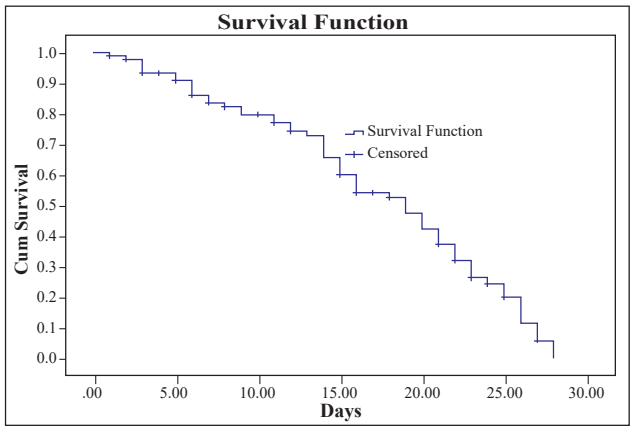

Figure 4: Kaplan Meier Curve

Figure 4 displays the Kaplan-Meier survival curve, showing cumulative survival probability over 30 days. It begins at 100% and declines as events (deaths) occur. "+" symbols represent censored data—patients lost to follow-up or who didn't experience the event. Survival drops to ~75% by day 10, 50% by day 20, and below 25% by day 30. The scattered censored points suggest variable follow-up. This curve emphasizes the progressive decline in survival and highlights the value of time-to-event analysis in evaluating outcome trends and associated factors.

Table XII: Receiver operating characteristic (ROC) curve of monocyte lymphocyte ratio (MLR) and neutrophil lymphocyte ratio (NLR) for prediction of acute respiratory distress syndrome

	Cut of value	Sensitivity	Specificity	AUC	P value	95% (CI) Upper bound	95% (CI) Lower bound
MLR	0.26	66.7	33.3	0.69	0.012	0.565	0.831
NLR	10.0	61.9	53.8	0.56	0.416	0.42	0.71

Table XII revealed MLR had significant predictive value for ARDS mortality (AUC 0.69, p=0.012) with 66.7% sensitivity and 33.3% specificity at a 0.26 cut-off. In contrast, NLR lacked statistical significance (p=0.416), indicating limited predictive utility.

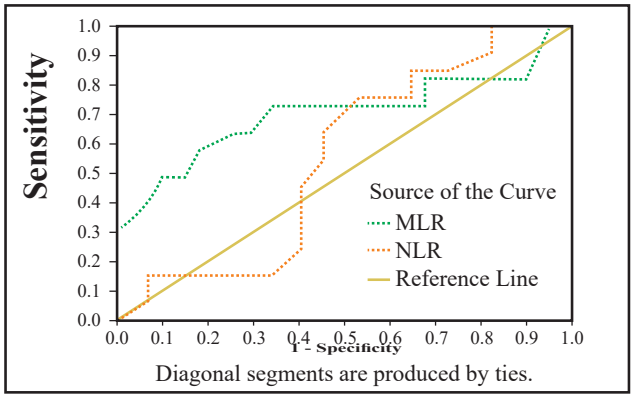

Figure 5: Receiver-operator characteristic (ROC) curve monocyte lymphocyte ratio and neutrophil-lymphocyte ratio for prediction of acute respiratory distress syndrome

The above figure compares ROC curves of MLR and NLR for ARDS mortality prediction. MLR showed significant predictive value (AUC 0.69, p=0.012) with 66.7% sensitivity at a 0.26 cut-off, while NLR lacked statistical significance (p=0.416), highlighting MLR's superior prognostic utility in ARDS.

Discussion

This study aimed to assess the Monocyte-to-Lymphocyte Ratio (MLR) at admission, evaluate 28-day mortality in ARDS patients, and explore the association between MLR and survival outcomes, supporting its role as a predictive marker of mortality.[14]

In this study on ARDS, mean Monocyte Lymphocyte Ratio (MLR) values varied across age and gender but were not statistically significant. Similar findings were reported in stroke-associated pneumonia, where MLR showed no age or gender association.[13] While MLR is a recognized inflammatory marker with prognostic value in conditions like sepsis and cancer,[18-19] its predictive role in ARDS remains complex and may not be influenced by demographic factors.[14]

In this study on ARDS, Monocyte-Lymphocyte Ratio (MLR) showed significant associations with clinical features such as labored breathing, low blood pressure, and extreme tiredness ($p < 0.05$), indicating a potential link between higher MLR and greater inflammatory burden. These findings align with prior research by Ng et al[20] and Messaoud-Nacer et al[21], who reported elevated MLR in patients with respiratory distress and systemic inflammation. However, MLR was not significantly associated with severe shortness of breath or crackles, contrasting with findings by Yang et al[17]. Interestingly, extreme tiredness was associated with lower MLR, differing from Karshikoff et al[22], possibly due to population differences. Overall, while MLR may not predict all ARDS symptoms, it remains a useful marker of inflammation.[13]

Monocyte Lymphocyte Ratio (MLR) showed no significant association ($p > 0.05$) with diabetes, hypertension, or asthma/COPD in ARDS patients in our study, aligning with findings by Sun et al[23] and Wang et al[24], who also found limited predictive value of MLR in chronic diseases. However, studies like Zawiah et al[13] and Mazza et al[25] suggest its relevance varies across different clinical conditions.

This study found that Monocyte Lymphocyte Ratio (MLR) significantly increased with ARDS severity, supporting its role as a predictor of mortality. These findings align with Tang et al[26] and Sofianos et al[27], who reported higher MLR in severe ARDS. However, Villar et al[5] noted that MLR's predictive accuracy may vary across populations, suggesting its effectiveness depends on clinical context.

This study shows a significant association between ARDS severity and mortality, with 63.2% of non-survivors classified as having severe ARDS. The PaO_2/FiO_2 ratio was substantially lower in non-survivors compared to survivors,

indicating more severe hypoxemia. These findings align with Jabaudon et al[28] and Kansal et al[29], who found strong correlations between inflammation and ARDS severity. Sofianos et al[27] also reported high mortality in severe respiratory cases. The observed link between ARDS severity and elevated mortality supports the role of inflammatory markers like MLR in outcome prediction.[14] While Wieruszewski et al[7] noted that MLR's predictive accuracy may vary among populations, consistent findings across studies highlight its potential as a reliable prognostic tool in ARDS.

This study identified a significant negative correlation between Monocyte Lymphocyte Ratio (MLR) and PaO_2/FiO_2 ratio ($r = –0.314$; $p = 0.002$), indicating that higher MLR is associated with poorer oxygenation. This supports findings by Matthay et al[30], who linked elevated inflammatory markers with reduced oxygen exchange. Kansal et al[29] similarly found that lower PaO_2/FiO_2 ratios predicted worse outcomes in ARDS. However, Wieruszewski et al[7] observed that MLR may not consistently reflect response to oxygenation-focused interventions.

This study shows that the PaO_2/FiO_2 ratio has moderate predictive value for mortality in ARDS patients (AUC = 0.61, sensitivity = 62.5%, specificity = 48.3%), aligning with Esteve et al[31], who emphasized its usefulness alongside other clinical indicators in ICU settings.

The mean age of survivors was 60.37 ± 16.6 years in our study, while non-survivors averaged 62.42 ± 10.57 years, showing no statistically significant difference. Similarly, gender distribution showed no significant impact on outcomes, with more females among non-survivors. These findings align with studies by Nie et al[32], Chen et al[33] and Bellani et al[34], who also reported non-significant differences in age and sex between outcome groups. In contrast, Wang et al[35] and Yoo et al[36] found significant age-related differences, likely due to variations in study populations, healthcare systems, and methodologies. These inconsistencies underscore the complex interaction of demographic factors in ARDS prognosis and the need for context-specific analysis when evaluating predictors like age and sex.

In this study, severe shortness of breath was significantly more common in non-survivors (65.2%) than survivors (31.6%) ($p < 0.05$). Other symptoms—labored breathing, low blood pressure, extreme tiredness, and crackles—were more frequent in non-survivors but did not reach statistical significance. These findings align with prior research emphasizing the prognostic value of clinical features in ARDS progression and highlight the need for symptom-based risk assessment.[13-14]

The prevalence of comorbidities such as diabetes mellitus (DM), hypertension (HTN), and asthma/COPD was higher in non-survivors than survivors in our study, though not statistically significant ($p > 0.05$). DM was present in 53.7% of non-survivors vs. 31.6% of survivors, and HTN in 54.7% vs. 28.4%, respectively. These findings align with Chen et al[33], Nie et al[32], and Yoo et al[36], who also reported no significant differences in comorbidity prevalence between outcome groups. Similarly, Bellani et al[34] and Wang et al[35] found non-significant associations with DM and HTN. These results suggest that while common, comorbidities may not independently predict mortality in ARDS and require further investigation.[13]

In this study on ARDS, various hematological parameters were assessed as potential predictors of mortality, including hemoglobin (Hb), ESR, monocyte and lymphocyte counts, MLR, NLR, neutrophil count, and RBS. Notably, both MLR and NLR were significantly higher in non-survivors ($p < 0.05$), indicating their potential as prognostic markers. While Yoo et al[36] found significant differences in Hb levels, this study did not. Similarly, Chen et al[33] reported increased monocyte counts and MLR in non-survivors, consistent with our findings. Nie et al[32] emphasized the predictive role of NLR and N/LPR, though this study did not analyze N/LPR. Yang et al[17] also observed elevated MLR and NLR in non-survivors, reinforcing their prognostic value. Variations across studies may reflect differences in populations, disease severity, and analytical methods, underscoring ARDS's complex, multifactorial nature.

34.7% of patients survived in our study, while 65.3% were non-survivors, similar to Yoo et al[36] and Yang et al[17], who reported comparable survival distributions and linked higher MLR with increased 28-day mortality. In contrast, Chen et al[33] and Nie et al[32] reported lower mortality rates. These differences likely reflect variations in patient demographics, disease severity, and healthcare settings, emphasizing ARDS's complex and multifactorial nature.

In this study, 50% of ARDS-related deaths occurred between days 16–28, supporting Pratt et al[37], who linked late mortality to multiorgan failure. In contrast, Shekarnabi et al[38] observed earlier mortality peaks, highlighting how baseline lung injury and intervention timing critically influence ARDS outcomes and survival trajectories.

In this study on ARDS, the Kaplan–Meier survival curve revealed a progressive decline in survival probability: approximately 75% by day 10, 50% by day 20, and below 25% by day 30. Shekarnabi et al[38] highlighted the impact of early imaging and interventions on survival, especially in severe ARDS, while Devlin and O'Quigley[39] emphasized that survival patterns vary with intervention timing and patient-specific factors. The use of "+" markers for censored data reflects the variability in follow-up duration and outcome measurement.

This study also found Monocyte Lymphocyte Ratio (MLR) to be a better mortality predictor in ARDS than Neutrophil Lymphocyte Ratio (NLR), with an AUC of 0.69 ($p < 0.05$) vs. 0.56, consistent with Kandelouei et al[11] and Tudurachi et al[14]. Although NLR has value in other conditions, Muresan et al[12] and Stojkovic et al[40] suggest combining markers improves accuracy. MLR emerges as a moderate, low-cost, and practical prognostic tool**,** especially valuable in resource-limited settings like Bangladesh.

Limitations

The study was limited to one hospital in Dhaka with purposive sampling, introducing potential bias. Blood samples were sent at varying times, and differing reagents and machines may have affected CBC result consistency.

Conclusion

The Monocyte-Lymphocyte Ratio (MLR) moderately predicts mortality in ARDS ICU patients and, being cost-effective and simple, serves as a practical prognostic tool in resource-limited healthcare settings like ours.

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