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# A Prospective Observational Study To Compare Predictive Value of Neutrophil to Lymphocyte Ratio, Platelet to Lymphocyte Ratio in Predicting Mortality in Sepsis

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## Abstract

**Background:** Because systemic inflammation and immunological response are reflected in biomarkers such as NLR and PLR, early risk assessment for sepsis a major cause of critical illness can facilitate prompt intervention. The purpose of this study is to assess and contrast the predictive usefulness of NLR and PLR in predicting mortality among sepsis patients in a tertiary care setting.

**Methods:** Adult patients with a diagnosis of sepsis who were hospitalized to the intensive care unit (ICU) over a specified research period were included in this prospective observational study. At admission, laboratory results, clinical characteristics, and demographic information were documented. Complete blood counts were used to compute NLR and PLR. Patients were monitored for in-hospital mortality over a 28-day period. The predictive performance of NLR and PLR was evaluated using receiver operating characteristic (ROC) curve analysis.

**Results:** A total of 100 patients were enrolled in this trial. The platelet-to-lymphocyte ratio (PLR, $p = 0.039$) and the qSOFA score ($p = 0.02$) were found to be significant predictors of in-hospital mortality among sepsis patients using multivariable logistic regression. The ratio of neutrophils to lymphocytes (NLR) exhibited a marginally negative correlation ($p = 0.046$), and there was no significant correlation between age and death.

**Conclusion:** The qSOFA score was the best predictor of death in sepsis, however neither age nor gender were shown to be substantially related. PLR had a higher correlation with death than NLR among inflammatory markers, suggesting that it may have predictive value.

**Keywords:** Sepsis, Neutrophil-to-Lymphocyte Ratio (NLR), Platelet-to-Lymphocyte Ratio (PLR), Mortality, Biomarkers, Prognosis

## Introduction

When the body's response to an infection causes widespread inflammation, it can lead to sepsis, a potentially dangerous sickness that damages tissue, malfunctions organs, and can even be fatal. It is the leading cause of death for severely ill patients in the intensive care unit (ICU) [1].Sepsis continues to be a major global health concern, impacting more than 31.5 million individuals each year and having high fatality rates-above 55.8% in some areas, such as Western Asia[2,3]. Compared to affluent countries, the death rate from sepsis is significantly greater in developing countries like China and India. These figures demonstrate how urgently better diagnostic and treatment methods are needed [4].

Organ failure and an elevated risk of death are the results of sepsis, which is characterised by a dysregulated immunological and inflammatory response, endothelium damage, immune cell depletion, and coagulation dysfunction**.** [5,6,7] The absence of precise, trustworthy indicators makes diagnosing sepsis difficult. The presence of infection and systemic inflammatory reactions are usually the basis for the clinical diagnosis of sepsis [8]. Although SOFA and qSOFA are useful tools for diagnosing sepsis, their low early sensitivity emphasises the need for new biomarkers for prompt sepsis detection and prognosis[9,10]. Simple, reasonably priced biomarkers that represent systemic inflammation and immunological balance, NLR and PLR are useful indicators of the severity and prognosis of sepsis. [11, 12].

Increased values of PLR, it measures that combines platelet and lymphocyte counts, indicate more severe sepsis. PLR reflects coagulation and inflammatory abnormalities.[13] In sepsis, elevated NLR and PLR have become independent prognostic indicators that are highly correlated with severe inflammation, organ failure, and higher death[14,15,16].With a high rate of morbidity and mortality, sepsis remains a serious worldwide health concern. Organ failure and death are caused by a complicated pathophysiology that includes immunological dysfunction, coagulation problems, and extensive inflammation[17,18,19].Although clinical criteria and scoring systems are used to diagnose sepsis, the use of biomarkers like NLR and PLR has the potential to enhance prognostication, risk stratification, and early diagnosis[20,21,22].Further research is essential to validate these biomarkers, and the present study aims to compare the predictive value of NLR in assessing sepsis-related mortality.

## Material and Methods

Over the course of two years, this investigation was planned as a prospective observational study. Adult patients who were 18 years of age or older and who satisfied the SEPSIS-3 guidelines' diagnostic criteria for sepsis were included in the study cohort. Due to time constraints, only 100 individuals were included, even though the calculated sample size, which was 295 using the formula n=[Z1]2×P(1–P)/d2n = $[Z_1]^2 \times \{P(1–P)\}/d^2$, with P = 0.177, Z = 1.96 (with 95% confidence), and d = 0.0707, was 295. Adults with suspected or confirmed sepsis, high SOFA or qSOFA scores ≥2, and blood drawn within 24 hours of diagnosis were included in this prospective observational investigation.

Pregnancy, recent transfusions, cancer, haematological malignancies, long-term steroid usage, immune-suppression, or HIV were among the exclusion criteria. Complete hemograms were used to generate hematological indicators, such as NLR and PLR, which were then compared between survivors and non-survivors. SPSS version 20.0 was used to analyse the

data. ROC curve analysis, univariate logistic regression, chi-square test, and unpaired Student's t-test were among the statistical tests used. To evaluate the diagnostic performance of NLR and PLR, AUC was employed, and a p-value <0.05 was deemed significant.

**Observations and Results**

In this prospective observational study involving 100 patients with sepsis, the mean age was 54.74 ± 16.44 years. Most patients were in the 61–70 age group (31%), followed by 51–60 years (27%). Other age groups included 18–30 years (11%), 31–40 years (10%), 41–50 years (9%), and those above 70 years (12%). Among the study population, 58% were male and 42% were female.

Among the 100 patients with sepsis, 41% had a qSOFA score of 1, 30% had a score of 0, 22% had a score of 2, and 7% had a score of 3. The mean qSOFA score was 1.06 ± 0.90. These findings suggested that a higher qSOFA score was associated with increased severity and risk of mortality in sepsis, indicating its potential usefulness as a bedside tool for early risk stratification.

The baseline characteristics of the patients revealed a mean neutrophil percentage of 81.98 ± 7.60 and lymphocyte percentage of 9.65 ± 5.74. The mean platelet count was 252,453 ± 20,775.04, and the absolute lymphocyte count was 1,902.85 ± 1,599.59. The mean neutrophil to lymphocyte ratio (NLR) was 13.33 ± 10.57, and the platelet to lymphocyte ratio (PLR) was 224.50 ± 247.73. The average procalcitonin level was 10.76 ± 20.02

Out of the 100 patients included in the study, 79% survived while 21% did not survive. These findings indicated a mortality rate of 21% among patients with sepsis.

The analysis of mortality by age revealed that the mean age of survivors was 55.23 ± 16.74 years, while non-survivors had a mean age of 52.90 ± 15.53 years. The highest percentage of non-survivors (38.10%) was observed in the 51–60 age group, followed by 31–40 years (14.29%) and 61–70 years (19.05%). However, the age differences between survivors and non-survivors were not statistically significant (p-value = 0.56), suggesting that age did not significantly influence mortality in this study.

Among the study participants, 39.24% of female patients survived, while 52.38% did not survive. In contrast, 60.76% of male patients survived, with 47.62% of them not surviving. The difference in mortality between genders was not statistically significant, with a p-value of 0.29, indicating that gender did not have a strong association with mortality in this cohort.

The majority of survivors had lower SOFA scores, with 40.5% scoring 2. In contrast, non-survivors had higher scores, with 28.6% scoring 6 and others scoring up to 11. The mean SOFA score was significantly higher in non-survivors (6.67 ± 2.43) compared to survivors (3.24 ± 1.34), with a statistically significant difference ($p < 0.0001$), indicating higher SOFA scores on admission were associated with increased mortality.

The qSOFA score showed a significant association with mortality ($p = 0.017$). Higher scores correlated with increased deaths, with only 2.53% survival at a score of 3. Mean qSOFA was 0.94 in survivors and 1.49 in non-survivors, indicating its utility in predicting mortality among sepsis patients.

There was no statistically significant difference in mean neutrophil, lymphocyte, platelet count, absolute lymphocyte count, or procalcitonin levels between survivors and non-survivors. Neutrophil and lymphocyte counts were similar across groups ($p = 0.73$ and $p = 0.76$, respectively). Platelet count was higher in

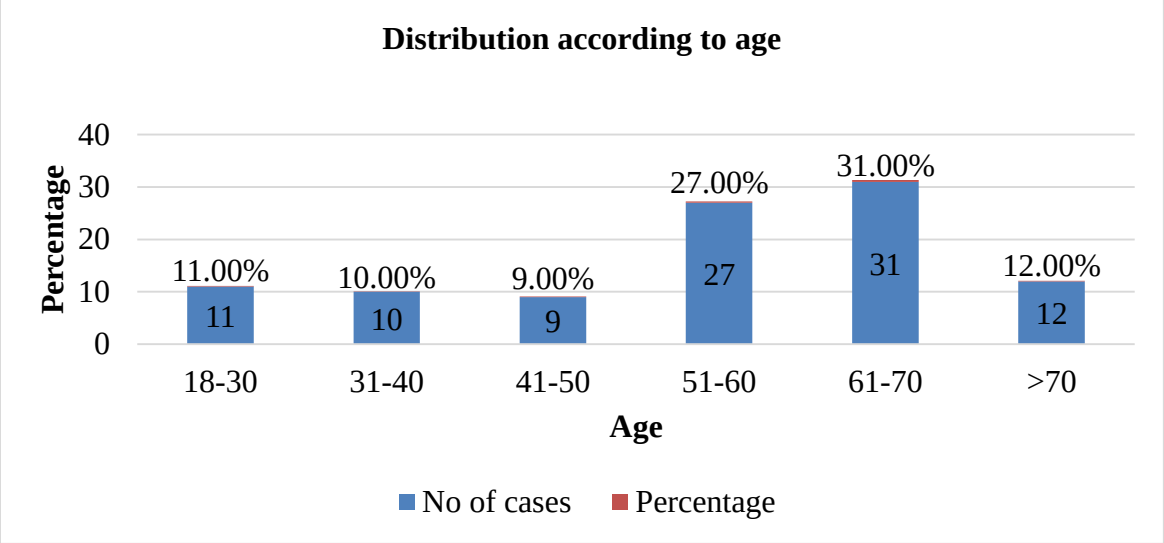
survivors but not significant (p = 0.79). Although the absolute lymphocyte count was higher in non-survivors, it did not reach significance (p = 0.11). The mean NLR (p = 0.41) and PLR (p = 0.16) also did not differ significantly between groups, indicating no strong association with mortality in this cohort.

Multivariable logistic regression revealed that qSOFA score and PLR were significant predictors of in-hospital mortality in sepsis, with qSOFA being the strongest. Age was not associated with mortality. NLR showed a marginal inverse relationship, while higher PLR correlated with increased mortality, highlighting their potential prognostic value.

Table 1: Distribution according to demographic characteristics

| Variables | No of cases | Percentage |
|---|---|---|
| Age | | |
| 18-30 | 11 | 11.00% |
| 31-40 | 10 | 10.00% |
| 41-50 | 9 | 9.00% |
| 51-60 | 27 | 27.00% |
| 61-70 | 31 | 31.00% |
| >70 | 12 | 12.00% |
| Total | 100 | 100.00% |
| Mean ± SD | 54.74 ± 16.44 | |
| Gender | | |
| Female | 42 | 42.00% |
| Male | 58 | 58.00% |

Graph 1: Distribution according to age



Graph 2: Distribution according to gender

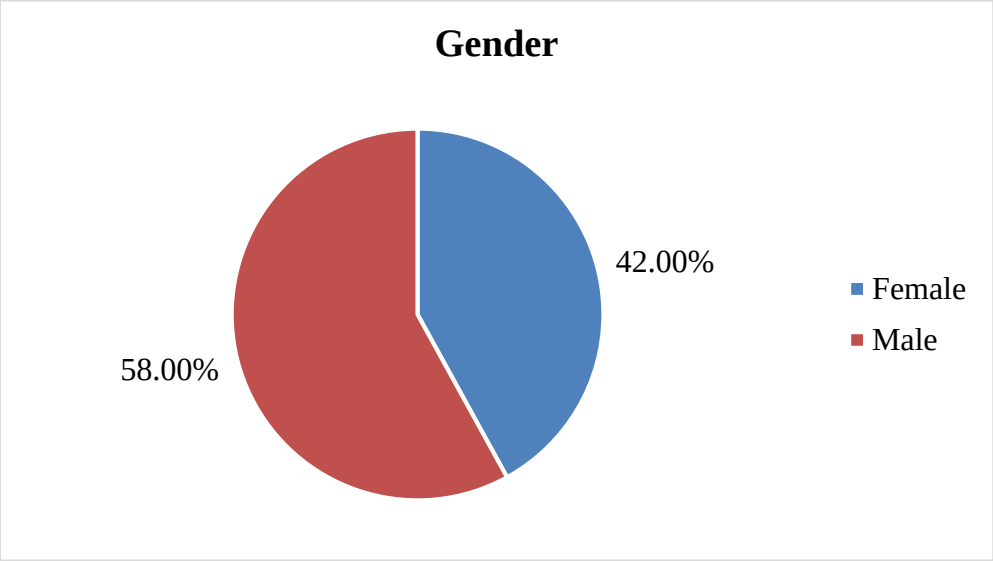



Table 2: qSOFA score

| qSOFA score | No of cases | Percentage |
|---|---|---|
| 0 | 30 | 30.00% |
| 1 | 41 | 41.00% |
| 2 | 22 | 22.00% |
| 3 | 7 | 7.00% |
| Mean ± SD | 1.06 ± 0.90 | |
| P-value | 0.00001 | |

Graph 3: qSOFA score

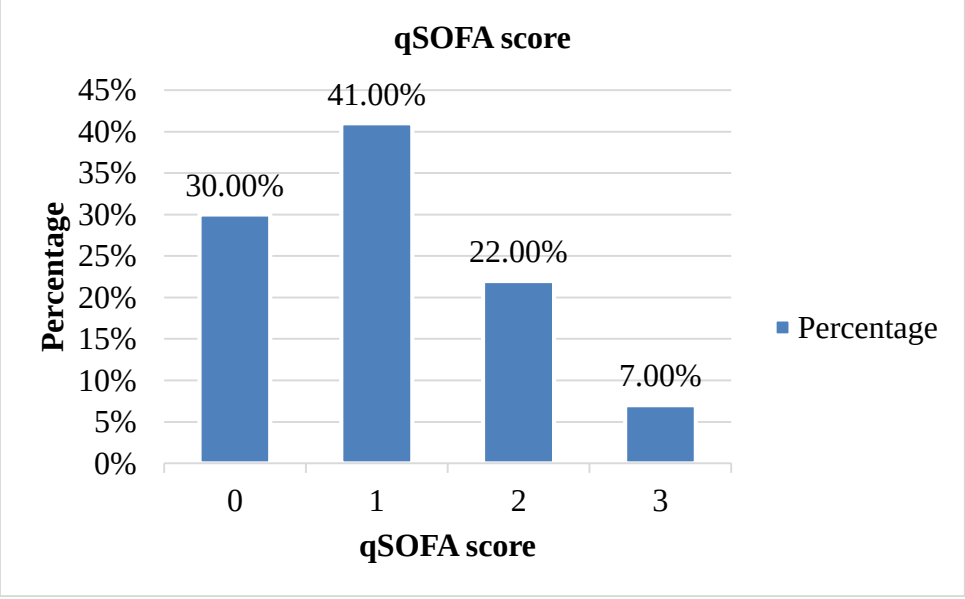


Table 3: Patients baseline characteristics

| Variables | Mean ± SD |
|---|---|
| Neutrophils | 81.98 ± 7.60 |
| Lymphocyte | 9.65 ± 5.74 |
| Platelet | 252453 ± 20775.04 |
| Absolute lymphocyte count | 1902.85 ± 1599.59 |
| Neutrophil to lymphocyte ratio | 13.33 ± 10.57 |
| Platelet to lymphocyte ratio | 224.50 ± 247.73 |
| Procalcitonin | 10.76 ± 20.02 |

Table 4: Distribution according to outcome -mortality

| Outcome -mortality | No of cases | Percentage |
|---|---|---|
| Survived | 79 | 79.00% |
| Non-survived | 21 | 21.00% |
| Total | 100 | 100.00% |

Graph 4: Distribution according to outcome -mortality

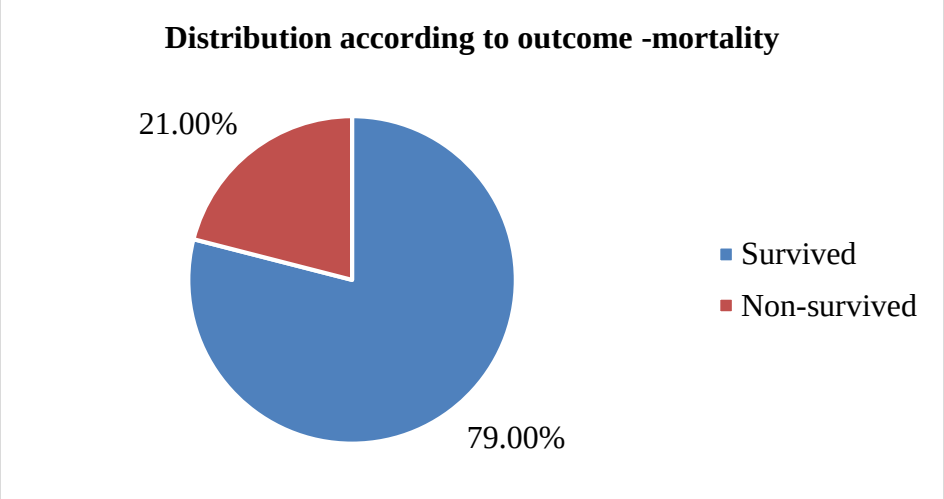



Table 5: Mortality associated with age of the study participants

| Variables | Survived | | Non-Survived | |
|---|---|---|---|---|
| Age | No of cases | Percentage | No of cases | Percentage |
| 18-30 | 9 | 11.39% | 2 | 9.52% |
| 31-40 | 7 | 8.86% | 3 | 14.29% |
| 41-50 | 7 | 8.86% | 2 | 9.52% |
| 51-60 | 19 | 24.05% | 8 | 38.10% |

| | | | | |
|---|---|---|---|---|
| 61-70 | 27 | 34.18% | 4 | 19.05% |
| >70 | 10 | 12.66% | 2 | 9.52% |
| Total | 79 | 100.00% | 21 | 100.00% |
| Mean ± SD | 55.23 ± 16.74 | | 52.90 ± 15.53 | |
| P-value | 0.56 | | | |

Graph 5: Mortality associated with age of the study participants

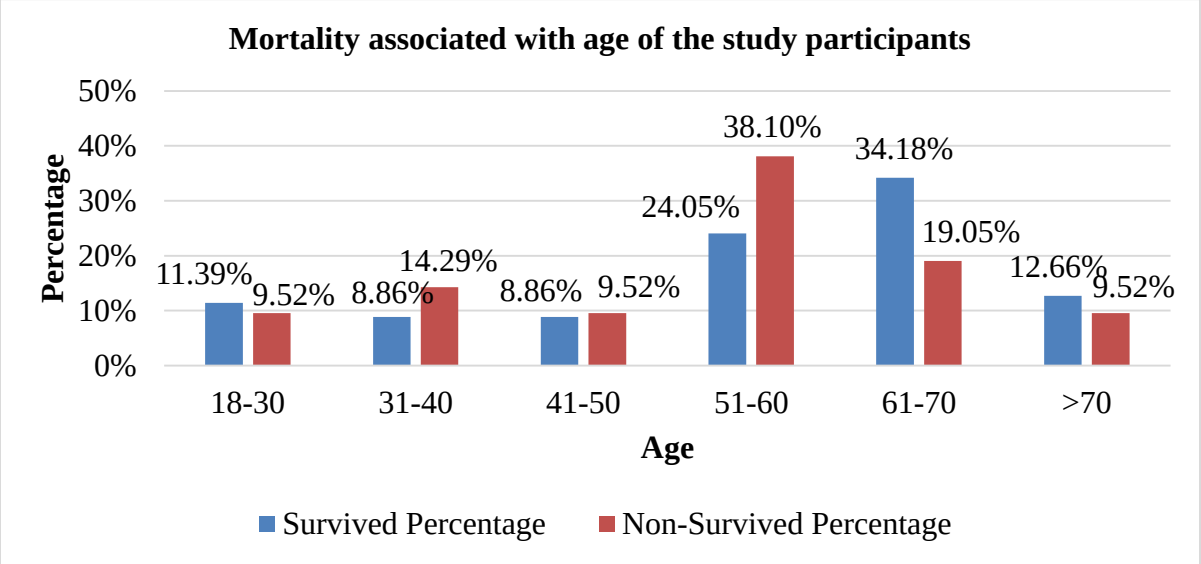



Table 6: Mortality according to gender of the study participants

| Gender | Survived | | Non-Survived | | P-value |
|---|---|---|---|---|---|
| | No of cases | Percentage | No of cases | Percentage | |
| Female | 31 | 39.24% | 11 | 52.38% | 0.29 |
| Male | 48 | 60.76% | 10 | 47.62% | |

Graph 6: Mortality according to gender

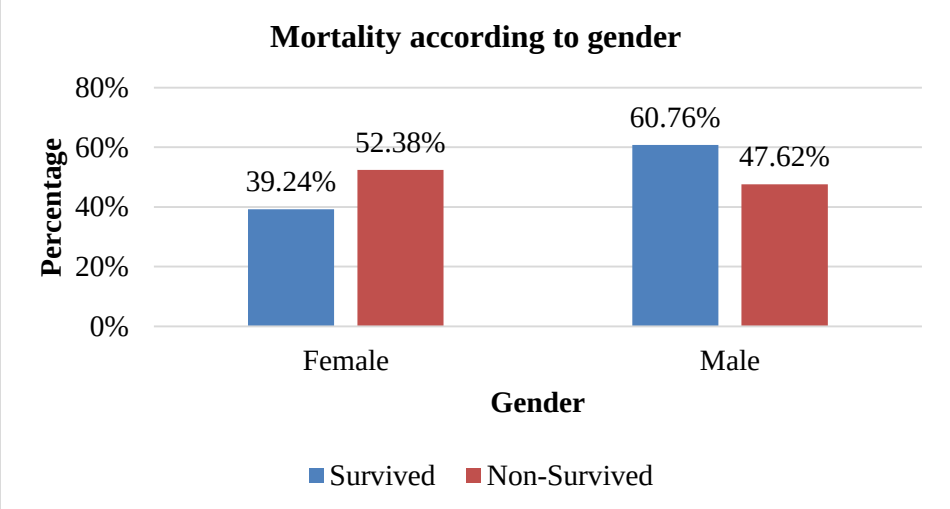


Table 7: SOFA score on admission with mortality

| SOFA score on admission | Survived | | Non-Survived | | Total | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| 2 | 32 | 40.51% | 0 | 0.00% | 32 | 32.00% |
| 3 | 17 | 21.52% | 1 | 4.76% | 18 | 18.00% |
| 4 | 16 | 20.25% | 5 | 23.81% | 21 | 21.00% |
| 5 | 9 | 11.39% | 0 | 0.00% | 9 | 9.00% |
| 6 | 4 | 5.06% | 6 | 28.57% | 10 | 10.00% |
| 7 | 0 | 0.00% | 2 | 9.52% | 2 | 2.00% |
| 8 | 1 | 1.27% | 1 | 4.76% | 2 | 2.00% |
| 9 | 0 | 0.00% | 3 | 14.29% | 3 | 3.00% |
| 10 | 0 | 0.00% | 1 | 4.76% | 1 | 1.00% |
| 11 | 0 | 0.00% | 2 | 9.52% | 2 | 2.00% |
| Total | 79 | 100.00% | 21 | 100.00% | 100 | 100.00% |
| Mean ± SD | 3.24 ± 1.34 | | 6.67 + 2.43 | | 3.96 + 2.14 | |
| P-value | <0.0001 | | | | | |

Graph 7: SOFA score on admission with mortality

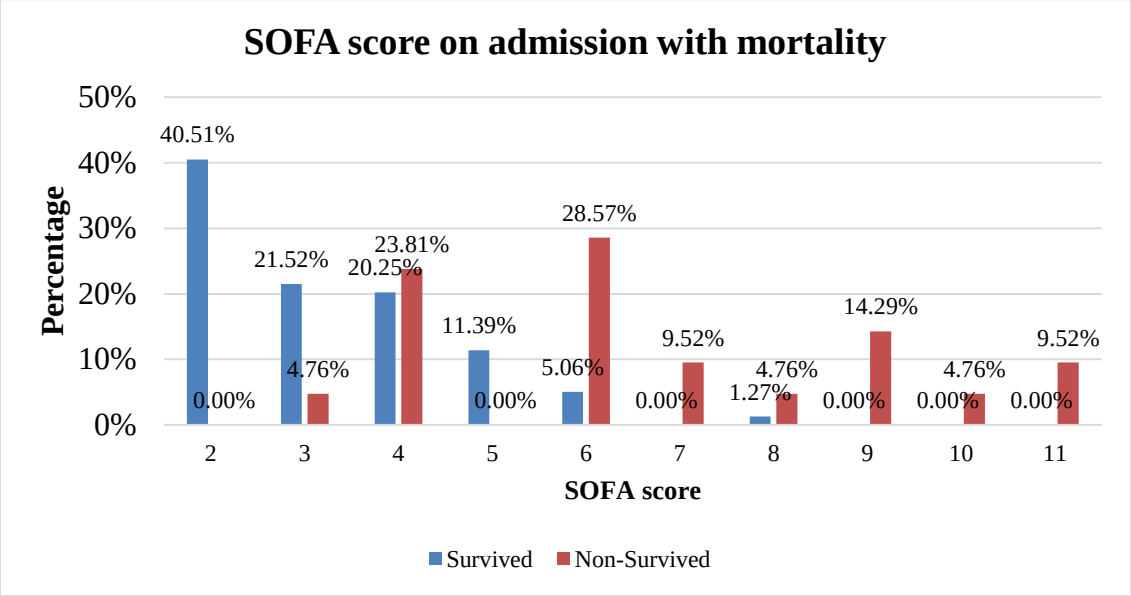



Table 8: Mortality according to qSOFA score

| qSOFA score | Survived | | Non-Survived | | P-value |
|---|---|---|---|---|---|
| | No of cases | Percentage | No of cases | Percentage | |
| 0 | 26 | 32.91% | 4 | 19.05% | 0.017 |
| 1 | 33 | 41.77% | 8 | 38.10% | |

| | | | | |
|---|---|---|---|---|
| 2 | 18 | 22.78% | 4 | 19.05% |
| 3 | 2 | 2.53% | 5 | 23.81% |
| Mean ± SD | 0.94 ± 0.81 | | 1.49 + 1.08 | |

Graph 8: Mortality according to qSOFA score

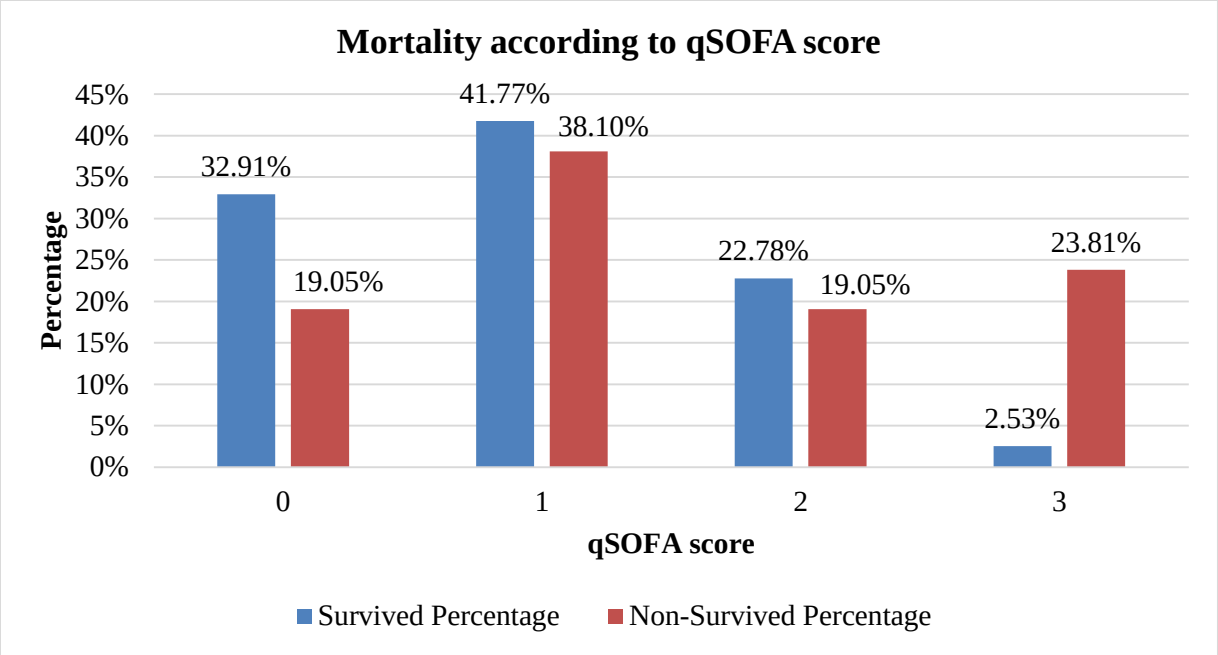
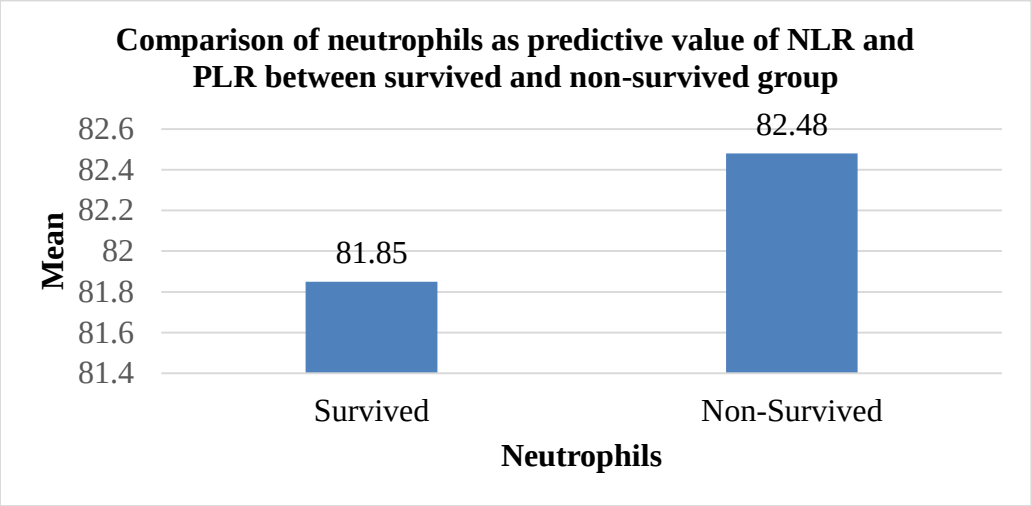


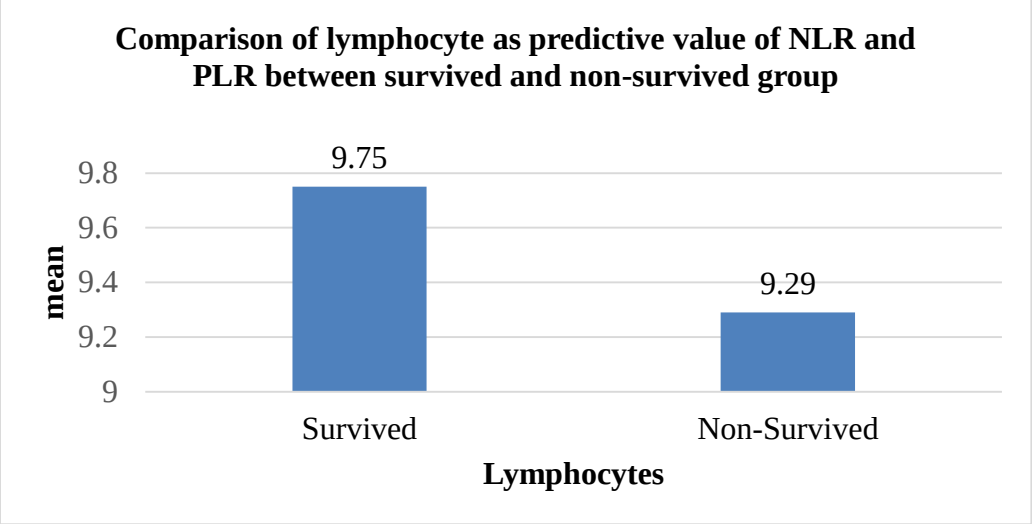

Table 9: Comparison of predictive value of neutrophil to lymphocyte ratio, platelet to lymphocyte ratio in predicting mortality in sepsis

| Variables | Survived | Non-Survived | P-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| Neutrophils | 81.85 ± 7.30 | 82.48 ± 8.84 | 0.73 |
| Lymphocyte | 9.75 ± 5.67 | 9.29 ± 6.12 | 0.76 |
| Platelet | 278291.14 ± 209625.62 | 155252.38 ± 139992.80 | 0.79 |
| Absolute lymphocyte count | 1771.83 ± 1398.87 | 2395.71 ± 2170.48 | 0.11 |
| Neutrophil to lymphocyte ratio | 12.88 ± 10.25 | 15.03 ± 11.78 | 0.41 |
| Platelet to lymphocyte ratio | 242.75 ± 243.80 | 155.81 ± 256.33 | 0.16 |
| Procalcitonin | 10.77 ± 20.65 | 10.74 ± 17.40 | 0.99 |

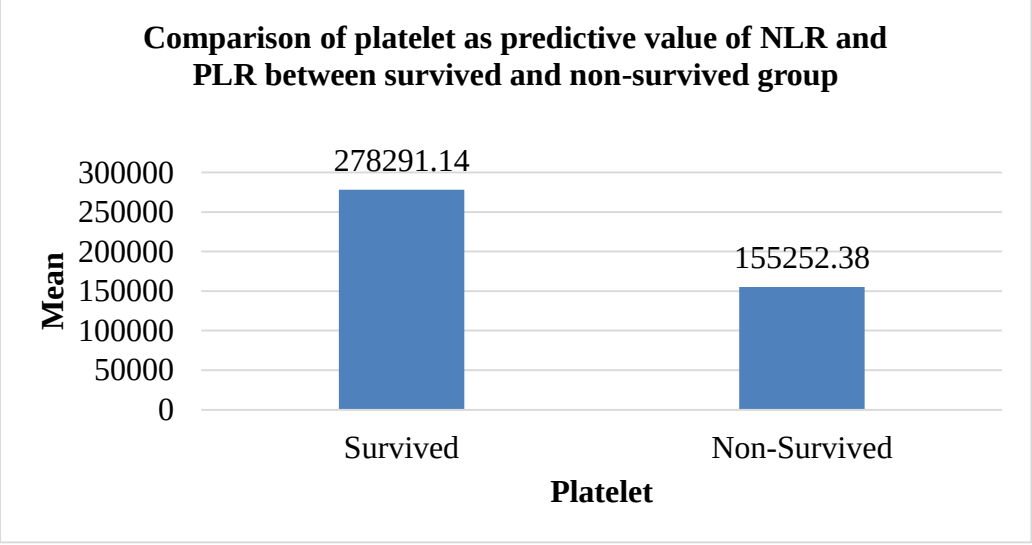
Graph 9: Comparison of neutrophils as predictive value of NLR and PLR between survived and non-survived group



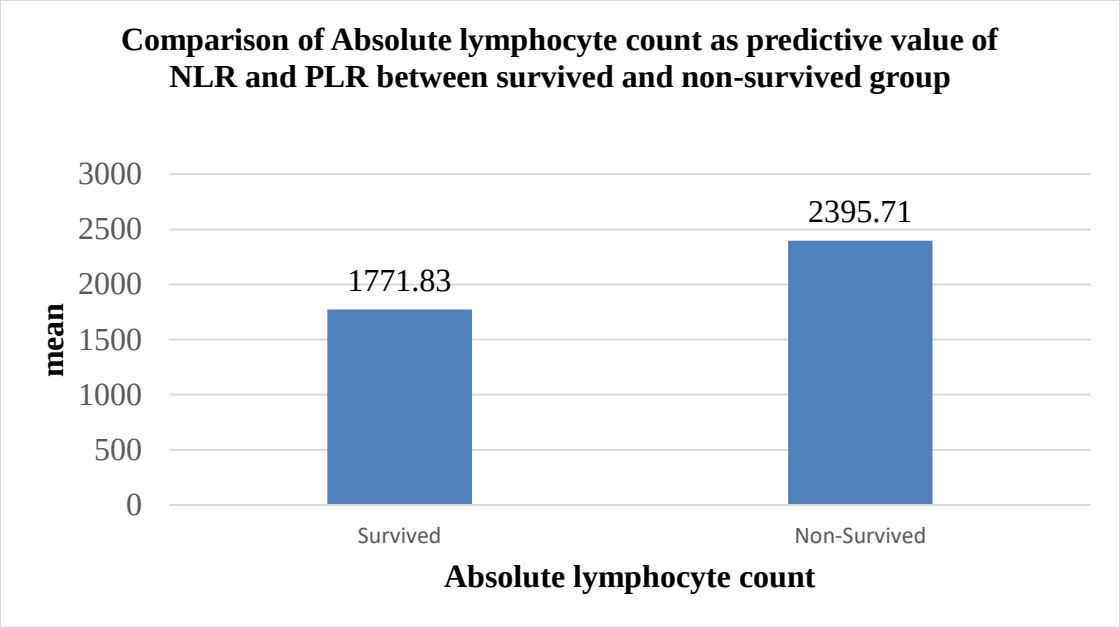

Graph 10: Comparison of lymphocyte as predictive value of NLR and PLR between survived and non-survived group



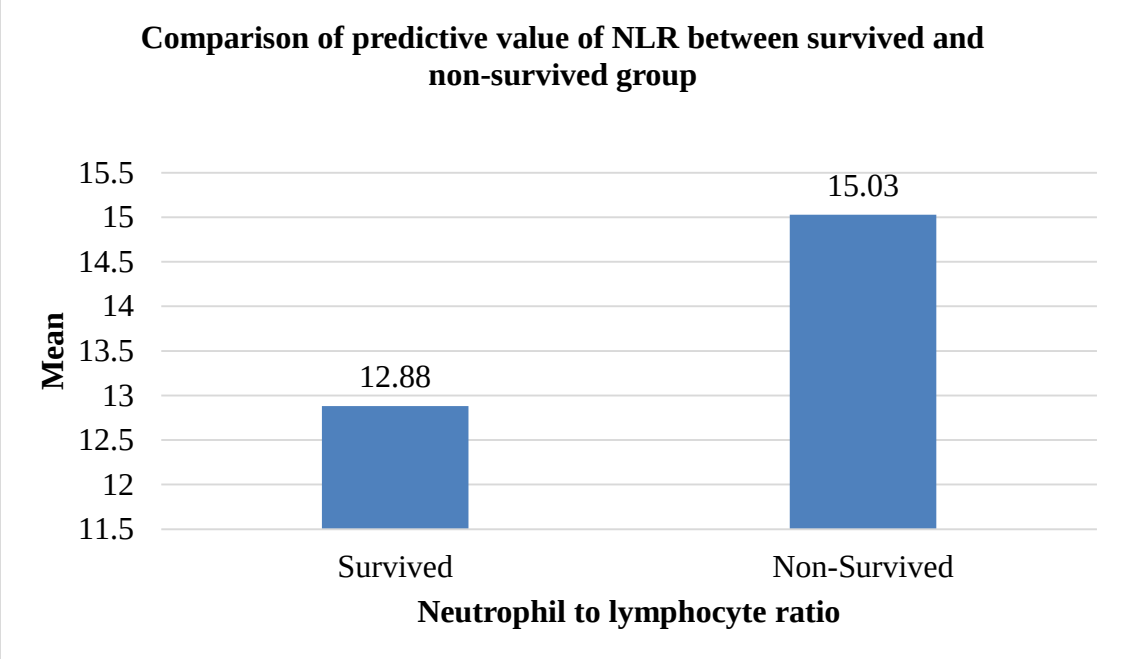

Graph 11: Comparison of platelet as predictive value of NLR and PLR between survived and non-survived group



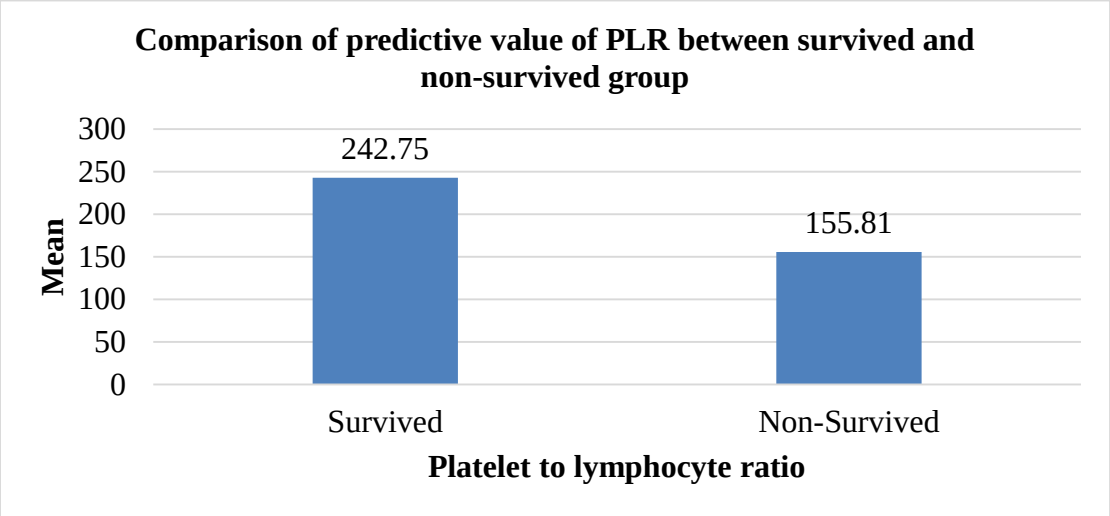
Graph 12: Comparison of Absolute lymphocyte count as predictive value of NLR and PLR between survived and non-survived group




Graph 13: Comparison of predictive value of NLR between survived and non-survived group



Graph 14: Comparison of predictive value of PLR between survived and non-survived group




Graph 15: Comparison of predictive value of Procalcitoninbetween survived and non-survived group

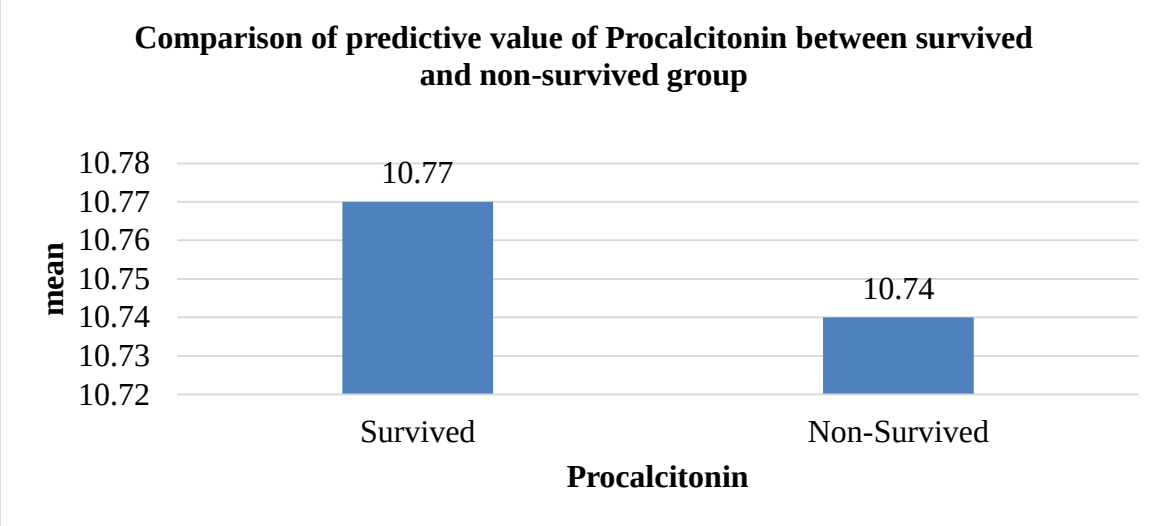



Table 10: Multivariable logistic regressions exploring the association of NLR and PLR with in-hospital mortality.

| | Coefficient B | Standard error | z | p | Odds Ratio | 95% conf. Interval |
|---|---|---|---|---|---|---|
| Age | 0.01 | 0.01 | 0.58 | 0.564 | 1.01 | 0.98 - 1.04 |
| qSOFA Score | 0.65 | 0.28 | 2.33 | 0.02 | 1.92 | 1.11 - 3.32 |
| Neutrophil To Lymphocyte Ratio | -0.06 | 0.03 | 2 | 0.046 | 0.95 | 0.89 – 1 |
| Platelet To Lymphocyte Ratio | 0 | 0 | 2.07 | 0.039 | 1 | 1 - 1.01 |

**Discussion**

A deregulated immune response to infection causes widespread inflammation, immune cell imbalance, and progressive organ damage in sepsis, a potentially fatal illness. The Neutrophil-to-Lymphocyte Ratio (NLR) and the Platelet-to-Lymphocyte Ratio (PLR) are becoming affordable hematological indicators that show immunological deregulation and systemic inflammation. One hundred adult patients who met the SEPSIS-3 criteria for sepsis were enrolled in this prospective

observational study. The average age was 54.74 years, and 58% of the population was male. There was a significant association between the qSOFA score and mortality, with non-survivors having higher mean values (1.49 vs. 0.94, p = 0.017).

Patients with poorer outcomes had higher NLR and PLR scores. PLR was substantially linked to a higher risk of death (p = 0.039), but NLR had a little negative correlation with mortality (p = 0.046). PLR and qSOFA (p = 0.02, OR = 1.92) were found to be independent predictors of mortality using multivariable logistic regression. Additionally, there was a substantial correlation (p < 0.0001) between the SOFA score and death. The usefulness of qSOFA, SOFA, NLR, and PLR as early prognostic instruments in sepsis is supported by these results. The findings merit additional confirmation through larger multicenter studies to improve early risk classification and care in septic patients, notwithstanding limitations such as the limited sample size and single-center design.

**Conclusion**

The predictive value of the Neutrophil-to-Lymphocyte Ratio (NLR) and Platelet-to-Lymphocyte Ratio (PLR) in predicting death in sepsis patients was assessed in this prospective observational study. The age group of 61–70 years old had the highest occurrence among the 100 patients (mean age 54.74 ± 16.44 years). There was no discernible correlation between mortality and either gender or age, and the overall mortality rate was 21%. The greatest predictor was the qSOFA score, which was substantially correlated with mortality (p = 0.017). In multivariable analysis, PLR shown a greater correlation with mortality than NLR, indicating its possible prognostic utility, even though NLR and PLR were not independently predictive.

**Limitation**

This study has several important limitations. Firstly as a single-center study conducted at a tertiary care hospital, the findings may not be generalizable to other healthcare settings or populations. The study also only assessed mortality within a 28-day in-hospital period, omitting long-term outcomes such as 90-day survival or post-discharge complications. The exclusion of patients with cancer, immunosuppression, recent transfusions, or chronic steroid use, while necessary to reduce confounding, limits the external validity of the findings in a real-world ICU population. Moreover, potential confounding variables such as comorbidities, infection source, and timing of interventions were not fully adjusted for, which may have influenced both biomarker levels and outcomes. Lastly, as an observational study, the results can show associations but cannot establish causal relationships between biomarker levels and sepsis outcomes.

**Abbreviations**

NLR - Neutrophil-to-Lymphocyte Ratio, PLR - Platelet-to-Lymphocyte Ratio, qSOFA - Quick Sequential Organ Failure Assessment, SOFA- Sequential Organ Failure Assessment, AUC - Area Under the Curve, SPSS - Statistical Package for the Social Sciences, SD- Standard Deviation, HIV- Human Immunodeficiency Virus, OR - Odds Ratio, and CI -Confidence Interval.

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