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Dynamic neutrophil-to-lymphocyte-platelet ratio trajectories predict 30-day and 1-year mortality in sepsis: a retrospective cohort study based on MIMIC-IV 2.2

Yuting Zhong[1†], Liping Zhong[1†], Yuanjun Zhou[1], Yilin Liao[1] and Jingdan Deng[1*]

Abstract

Background This study investigated the relationship between the neutrophil-to-lymphocyte ratio (N/LPR) and its variability ratio (N/LPRR) with 30-day and 1-year mortality outcomes.

Methods A total of 7,443 patients from the MIMIC-IV 2.2 database were included, with 1,765 having multiple N/LPR measurements. Mortality at 1 year and within 30 days served as the primary endpoints. Patients were stratified into four groups according to baseline N/LPRR quartiles. Receiver operating characteristic (ROC) curves assessed the predictive value of N/LPR and N/LPRR for mortality. Kaplan–Meier analysis estimated the risk of mortality events, while restricted cubic spline (RCS) analysis explored the non-linear associations between N/LPR, N/LPRR, and mortality. Cox proportional hazards regression identified the relationship between N/LPRR and all-cause mortality.

Results A total of 792 cases of 1-year mortality (44.9%) were recorded, with 437 deaths (24.8%) occurring within 30 days. ROC analysis revealed that N/LPRR outperformed N/LPR in predicting adverse outcomes. Higher N/LPR and N/LPRR were associated with increased mortality rates. RCS analysis indicated significant non-linear relationships between N/LPR, N/LPRR, and mortality risk (both p-values for nonlinearity < 0.001). Subgroup analyses confirmed the robustness of these findings.

Conclusion In conclusion, elevated N/LPR and N/LPRR are linked to 30-day and 1-year mortality in patients with sepsis. N/LPRR, with its heightened sensitivity, offers clinicians valuable prognostic information on sepsis severity and progression.

Keywords Sepsis, Coagulation, Neutrophils, Lymphocytes, Mortality, Platelet

Introduction

Sepsis is a severe systemic response to infection, marked by immune dysregulation and coagulation dysfunction [1, 2]. It is the leading cause of intensive care unit (ICU) admissions, with mortality rates ranging from 28 to 40% despite aggressive treatment [3–6]. Moreover, persistent inflammation during ICU stay has been linked to increased post-ICU mortality [7–11]. Early identification of patients at risk for poor outcomes remains difficult due to the complex pathogenesis of sepsis. Thus, there is a critical need for novel, accessible biomarkers to more accurately predict disease severity and prognosis.

Clinical evaluation of sepsis primarily relies on inflammatory and coagulation markers, including neutrophils,

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- persistent inflammation during ICU stay has been linked to increased post-ICU mortality [7,8,9,10,11]. Early identification of patients at risk for poor outcomes remains difficult due to the complex pathogenesis of sepsis.

- Clinical evaluation of sepsis primarily relies on inflammatory and coagulation markers, including neutrophils, lymphocytes, C-reactive protein, calcitonin, and platelets (PLT). Each of these markers reflects specific aspects of the disease. Neutrophils and lymphocytes, key immune cells, play essential roles in the immune response. The neutrophil-to-lymphocyte ratio (NLR) in peripheral blood serves as a prognostic tool for patients with sepsis [12], but it does not account for coagulation status. In contrast, platelets bridge innate and adaptive immunity, significantly influencing both coagulation and inflammation [13, 14].

Introduction

- Recent research has highlighted that an elevated neutrophil-to-lymphocyte and platelet ratio (N/LPR) serves as a reliable short-term prognostic factor for critically ill patients. The N/LPR has shown strong predictive capacity for 28-day mortality in septic patients with acute respiratory distress syndrome (ARDS) and concomitant kidney injury [15, 16].

- Patients with sepsis exhibit significantly higher N/LPR values, which can predict 28-day mortality more effectively than NLR [17]. These findings suggest that N/LPR may serve as a valuable marker for predicting adverse outcomes in patients with sepsis.

- However, previous studies have primarily focused on the impact of baseline N/LPR on short-term prognosis. Evaluating prognosis solely based on baseline N/LPR may be insufficient due to potential fluctuations in inflammatory responses and coagulation status.

- Serial monitoring of biomarkers during hospitalization is particularly crucial for critically ill patients. There is limited evidence on the use of the variability ratio of N/LPR (N/LPRR) in predicting both short-term and long-term outcomes or in early risk stratification of patients with sepsis. This study aims to explore the relationship between dynamic changes in N/LPR and all-cause mortality.

Methods and materials

Database description and ethics issues

- Data for this study were sourced from the MIMIC-IV database (Medical Information Mart for Intensive Care-IV, version 2.2) [18], which contains information on tens of thousands of patients admitted to the ICU at Beth Israel Deaconess Medical Center (BIDMC) between 2008 and 2019.

- Researchers accessing this dataset must complete ethical training, pass relevant examinations, and obtain authorization. The principal investigator obtained data usage authorization and certification upon signing the data use agreement (No. 39149215).

- The study adhered to the principles outlined in the Declaration of Helsinki, and all procedures involving human data were conducted in accordance with these ethical guidelines.

Methods and materials

Study population

- The study population consisted of adult patients (aged 18 or older) diagnosed with sepsis, who were admitted to the ICU for the first time. Exclusion criteria included: (1) lack of available N/LPRR data; (2) absence of predefined laboratory results or vital signs; (3) ICU length of stay (LOS) < 1 day (patients with missing data due to early death or rapid discharge).

Data processing

- Baseline information, including demographic data, comorbidities, treatment interventions, severity scores, laboratory results, and vital signs, was gathered within the first 24 h of ICU admission. Comorbidities were identified through ICD- 9 or ICD- 10 codes. Details of all variables are provided in the baseline table. Admission N/LPR was calculated based on neutrophil, lymphocyte, and PLT counts measured during the initial ICU admission.

Methods and materials

- The fallowing formulas were used :

$$\mathrm{N/LPR} = \left(\text{neutrophil count}\left[\times 10^9\right] \times 100\right) / \left(\text{lymphocyte count}\left[\times 10^9\right] \times \text{PLT count}\left[\times 10^9\right]\right)$$

$$\mathrm{N/LPRR} = \left(\text{Mean N/LPR} - \text{admission N/LPR}\right) / \text{admission N/LPR}$$

- The mean N/LPR was calculated as the average of all N/LPR measurements taken during the hospital stay, excluding the first measurement after admission.

Methods and materials

Statistical analysis

- (1)Patients with at least two N/LPR measurements were classified into four groups based on the quartile distribution of dynamic changes in N/LPR. Descriptive statistics, including the median and interquartile range (IQR), were used to summarize continuous variables, given their non-normal distribution. The Kruskal–Wallis H-test was employed to assess differences between groups for continuous variables. the chi-square test was applied to examine between-group differences.

- (2) Receiver operating characteristic (ROC) curves were generated to assess the prognostic performance of NLR, PLT, N/LPR, and N/LPRR with respect to 30-day and 1-year mortality. The area under the curve (AUC) and the optimal cut-off value were determined.

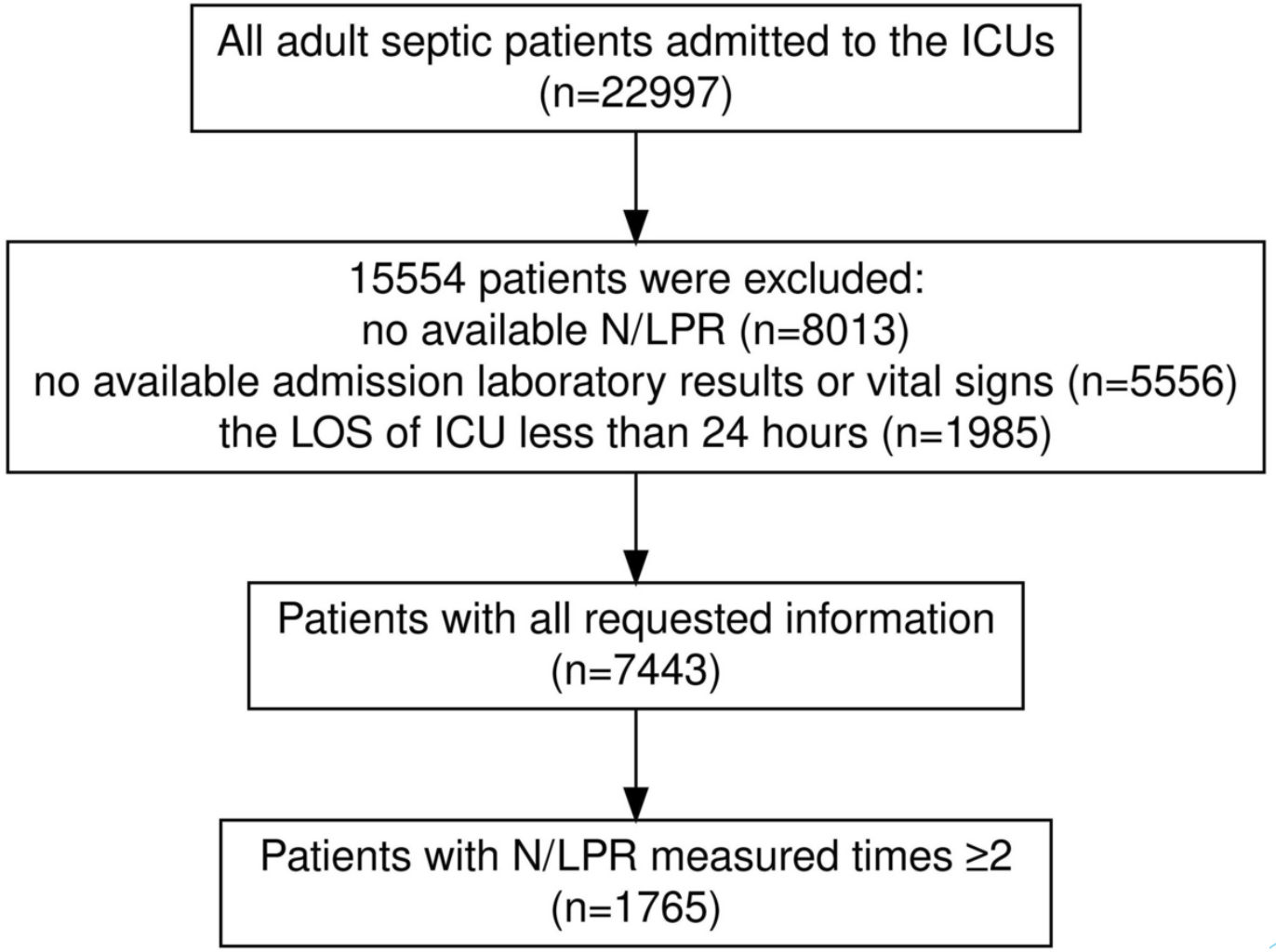
- (3) Kaplan–Meier curves were used to explore the relationship between the N/LPR index, N/LPRR, and mortality outcomes, with the Log-Rank test applied for statistical significance.

- (4) Restricted cubic spline (RCS) analysis was conducted to examine the non-linear relationships between N/LPR and N/LPRR and 30-day and 1-year mortality.

- All statistical analyses were performed using R software (version 4.3.1), with a significance level set at $p < 0.05$ (two-tailed).

Results

Baseline information



Results

Baseline information

- The average N/LPRR for the entire cohort was − 0.17 (Table 1). Patients were divided into four groups according to the quartiles of N/LPRR. The median age of the cohort was 64 years, with significant age differences across the groups.

- Additionally, significant between-group differences were found for comorbid conditions, including congestive heart failure, diabetes, malignancy, severe hepatic disorders, and metastatic solid tumors.

- Higher N/LPRR values were associated with increased rates of vasopressor use compared to the Q1 group. Moreover, an elevated N/LPRR index correlated with more severe disease scoring, abnormal laboratory findings, and altered vital signs. Notably, 437 cases (24.8%) experienced mortality within 30 days, while 792 cases (44.9%) died within one year. Higher N/LPRR levels were linked to increased 30-day and 1-year mortality. The baseline characteristics of the entire cohort are detailed in Supplementary Table 1.

Table 1 Baseline characteristics of septic patients with N/LPR measured times ≥ 2

Characteristic	N/LPRR quartile group					*p*
	Overall, *N* = 1765	Q1, *N* = 442	Q2, *N* = 441	Q3, *N* = 441	Q4, *N* = 441	
N/LPRR	− 0.17 [− 0.61, 0.74]	− 0.79 [− 0.88, − 0.70]	− 0.45 [− 0.54, − 0.32]	0.17 [0.00, 0.42]	2.32 [1.32, 5.21]	< 0.001
Age(years)	64 [53, 76]	61 [50, 71]	65 [51, 76]	66 [56, 78]	66 [56, 76]	< 0.001
Sex, female	769 (43.6)	209 (47.3)	176 (39.9)	177 (40.1)	207 (46.9)	0.029
Race						0.854
White	1,108 (62.8)	283 (64.0)	283 (64.2)	271 (61.5)	271 (61.5)	
Black	183 (10.4)	37 (8.4)	49 (11.1)	46 (10.4)	51 (11.6)	
Asian	56 (3.2)	15 (3.4)	12 (2.7)	13 (2.9)	16 (3.6)	
Others	418 (23.7)	107 (24.2)	97 (22.0)	111 (25.2)	103 (23.4)	
Comorbidities						
Myocardial infarction	285 (16.1)	63 (14.3)	64 (14.5)	83 (18.8)	75 (17.0)	0.203
Congestive heart failure	559 (31.7)	116 (26.2)	146 (33.1)	168 (38.1)	129 (29.3)	0.001
Cerebrovascular diseases	248 (14.1)	64 (14.5)	69 (15.6)	60 (13.6)	55 (12.5)	0.577
COPD	442 (25.0)	104 (23.5)	114 (25.9)	125 (28.3)	99 (22.4)	0.184
Diabetes	540 (30.6)	115 (26.0)	152 (34.5)	148 (33.6)	125 (28.3)	0.016
Chronic renal disease	419 (23.7)	92 (20.8)	105 (23.8)	112 (25.4)	110 (24.9)	0.375
Carcinoma	371 (21.0)	65 (14.7)	80 (18.1)	90 (20.4)	136 (30.8)	< 0.001
Severe liver diseases	228 (12.9)	37 (8.4)	54 (12.2)	65 (14.7)	72 (16.3)	0.003
Metastatic solid tumor	140 (7.9)	27 (6.1)	28 (6.3)	32 (7.3)	53 (12.0)	0.003

Therapies						
Renal replace therapy	177 (10.0)	43 (9.7)	34 (7.7)	49 (11.1)	51 (11.6)	0.222
Mechanical ventilation	921 (52.2)	237 (53.6)	225 (51.0)	231 (52.4)	228 (51.7)	0.884
Dopamine	63 (3.6)	12 (2.7)	19 (4.3)	19 (4.3)	13 (2.9)	0.418
Epinephrine	62 (3.5)	10 (2.3)	6 (1.4)	19 (4.3)	27 (6.1)	< 0.001
Norepinephrine	733 (41.5)	172 (38.9)	170 (38.5)	181 (41.0)	210 (47.6)	0.022
Vasopressin	237 (13.4)	53 (12.0)	40 (9.1)	57 (12.9)	87 (19.7)	< 0.001
Disease scores						
SOFA	4 [2, 5]	3 [2, 5]	3 [2, 5]	4 [2, 5]	4 [2, 6]	0.039
SAPSIII	43 [33, 54]	40 [31, 50]	42 [31, 52]	43 [35, 55]	47 [37, 58]	< 0.001
APSIII	58 [45, 74]	56 [42, 72]	55 [44, 70]	59 [45, 75]	63 [49, 81]	< 0.001
OASIS	36 [30, 42]	36 [30, 41]	35 [30, 41]	36 [30, 42]	36 [30, 44]	0.334
GCS	15 [13, 15]	15 [13, 15]	15 [13, 15]	15 [13, 15]	15 [14, 15]	0.308
Laboratory results						

Laboratory results						
HRR	0.66 [0.52, 0.83]	0.70 [0.54, 0.83]	0.66 [0.53, 0.86]	0.67 [0.54, 0.82]	0.61 [0.48, 0.76]	< 0.001
WBC(109/L)	12 [8, 18]	13 [9, 19]	13 [9, 19]	12 [8, 17]	11 [6, 17]	< 0.001
Bicarbonate(mmol/L)	21.0 [18.0, 24.5]	21.0 [18.5, 24.4]	22.0 [19.0, 25.5]	21.5 [18.0, 24.5]	20.0 [17.0, 23.0]	< 0.001
Creatinine(mg/dl)	1.30 [0.85, 2.15]	1.25 [0.75, 2.25]	1.20 [0.85, 1.95]	1.35 [0.85, 2.25]	1.35 [0.95, 2.25]	0.010
Glucose(mg/dl)	139 [112, 184]	136 [108, 172]	141 [115, 190]	139 [112, 185]	142 [114, 187]	0.029
PT(s)	15 [13, 19]	15 [13, 17]	15 [13, 18]	15 [13, 20]	16 [14, 20]	< 0.001
APTT(s)	33 [28, 42]	32 [27, 39]	33 [28, 43]	33 [28, 42]	34 [29, 46]	0.003
ALT(U/L)	33 [19, 82]	35 [20, 91]	31 [18, 63]	30 [18, 85]	37 [19, 100]	0.020
AST(U/L)	53 [28, 131]	53 [30, 124]	50 [28, 96]	48 [25, 131]	62 [30, 175]	0.021
Total bilirubin(mg/dL)	0.80 [0.45, 1.85]	0.95 [0.50, 1.84]	0.80 [0.40, 1.80]	0.75 [0.40, 1.75]	0.80 [0.50, 2.05]	0.095
Albumin(g/dl)	3.0 [2.6, 3.5]	3.0 [2.5, 3.4]	3.1 [2.6, 3.6]	3.0 [2.6, 3.4]	2.9 [2.5, 3.4]	0.012
Vital signs						
Heart rate(beats/min)	92 [80, 105]	92 [80, 106]	92 [80, 105]	90 [79, 105]	92 [81, 105]	0.708
MBP(mmHg)	75 [69, 82]	76 [70, 83]	75 [70, 83]	75 [69, 81]	74 [69, 80]	0.014
RR(breaths/min)	21 [18, 24]	21 [18, 25]	21 [18, 23]	21 [17, 24]	21 [18, 24]	0.081
Temperature(℃)	36.9 [36.6, 37.4]	37.1 [36.7, 37.5]	37.0 [36.7, 37.4]	36.9 [36.6, 37.3]	36.8 [36.5, 37.2]	< 0.001
Spo2	97 [95, 98]	97 [95, 98]	97 [95, 98]	97 [95, 98]	97 [96, 99]	0.072
Outcomes						
1-year mortality	792 (44.9)	140 (31.7)	168 (38.1)	221 (50.1)	263 (59.6)	< 0.001
30-day mortality	437 (24.8)	48 (10.9)	82 (18.6)	137 (31.1)	170 (38.5)	< 0.001

Results

Association between the N/LPR index, N/LPRR and the 30-day/1-year mortality

- As shown in (Fig. 2 and Table 2) higher N/LPRR was significantly associated with increased 30-day and 1-year mortality. However, no significant difference was observed in mortality between the Q1 and Q2 groups regarding N/LPR ($p = 0.174$ for 30-day mortality, $p = 0.163$ for 1-year mortality).

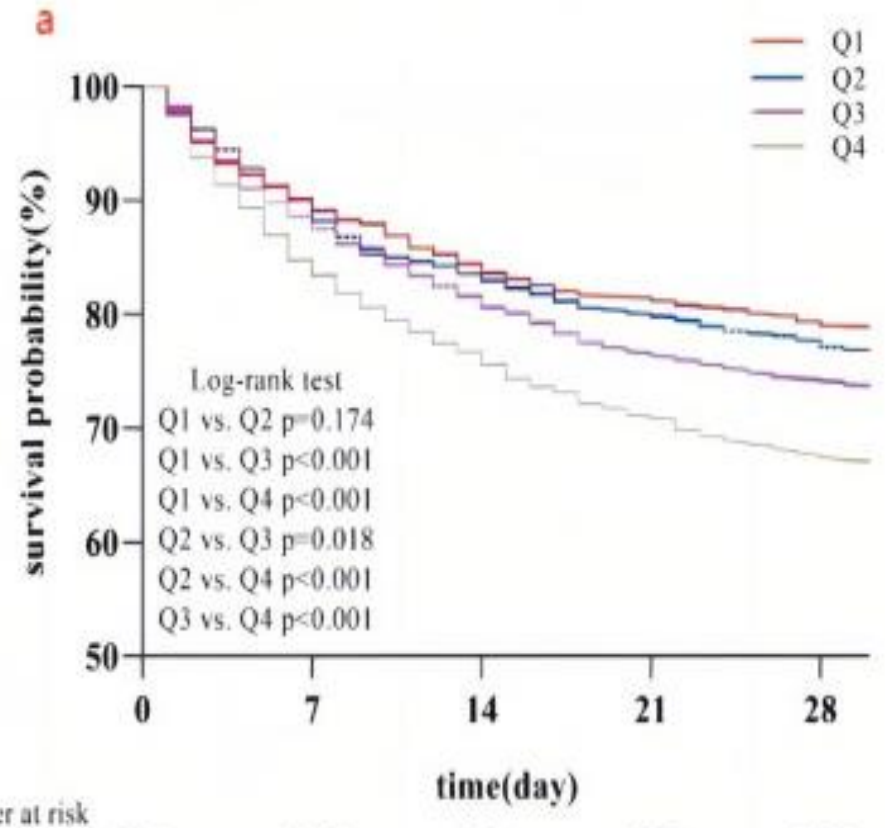
Non-linear associations between N/LPR, N/LPRR with outcomes

- After adjusting for confounding factors, RCS analysis (Fig. 3) identified a non-linear association between N/LPR and 30-day/1-year mortality (p-values for nonlinearity < 0.001 for both 30-day and 1-year mortality, Fig. 3a and b). Similarly, N/LPRR showed a non-linear relationship with both 30-day and 1-year mortality (p-values for nonlinearity $= 0.006$ and < 0.001, respectively, Fig. 3c and d). Both baseline N/LPR and N/LPRR were positively associated with increased mortality risk within certain thresholds.

Classification accuracy of N/LPR index and N/LPRR for 30-day and 1-year mortality

- both N/LPR and N/LPRR demonstrated predictive value for 30-day and 1-year mortality. N/LPRR displayed the highest AUC for both 30-day and 1-year mortality (0.661 and 0.619, respectively), suggesting its strong potential for predicting survival outcomes. In comparison, N/LPR, NLR, PLT and SOFA score showed lower predictive accuracy for all-cause mortality (Supplementary Fig. 1).

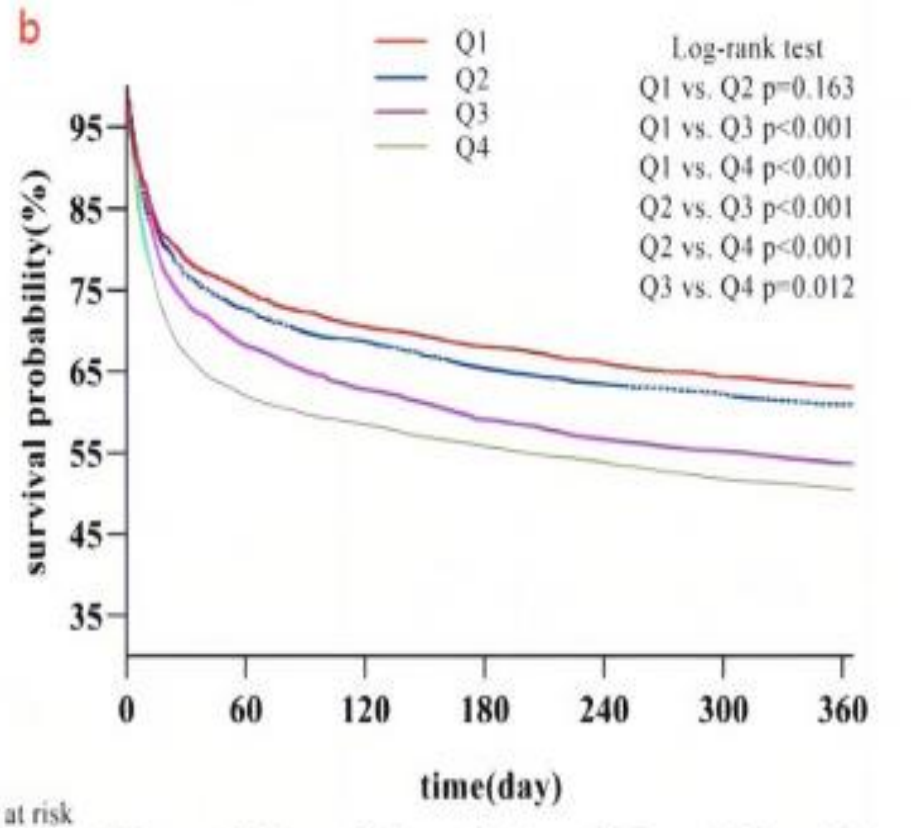
N/LPR Kaplan-Meier survival curve for 30-day mortality



Number at risk

Q1 group	1860	1657	1556	1510	1470
Q2 group	1862	1642	1544	1486	1436
Q3 group	1861	1629	1501	1421	1379
Q4 group	1860	1552	1406	1317	1253

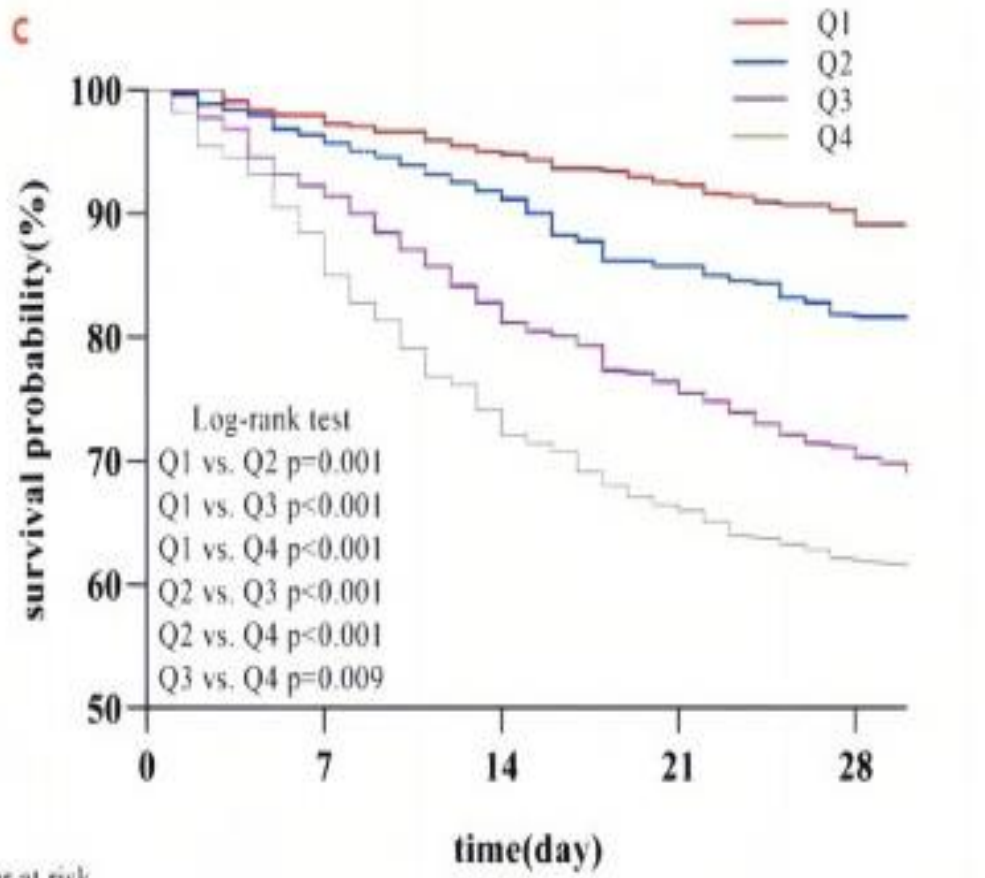
N/LPR Kaplan-Meier survival curve for 1-year mortality



Number at risk

Q1 group	1860	1391	1311	1266	1277	1197	1174
Q2 group	1862	1352	1278	1217	1181	1158	1135
Q3 group	1861	1268	1168	1100	1055	1027	996
Q4 group	1860	1152	1086	1036	1002	962	939

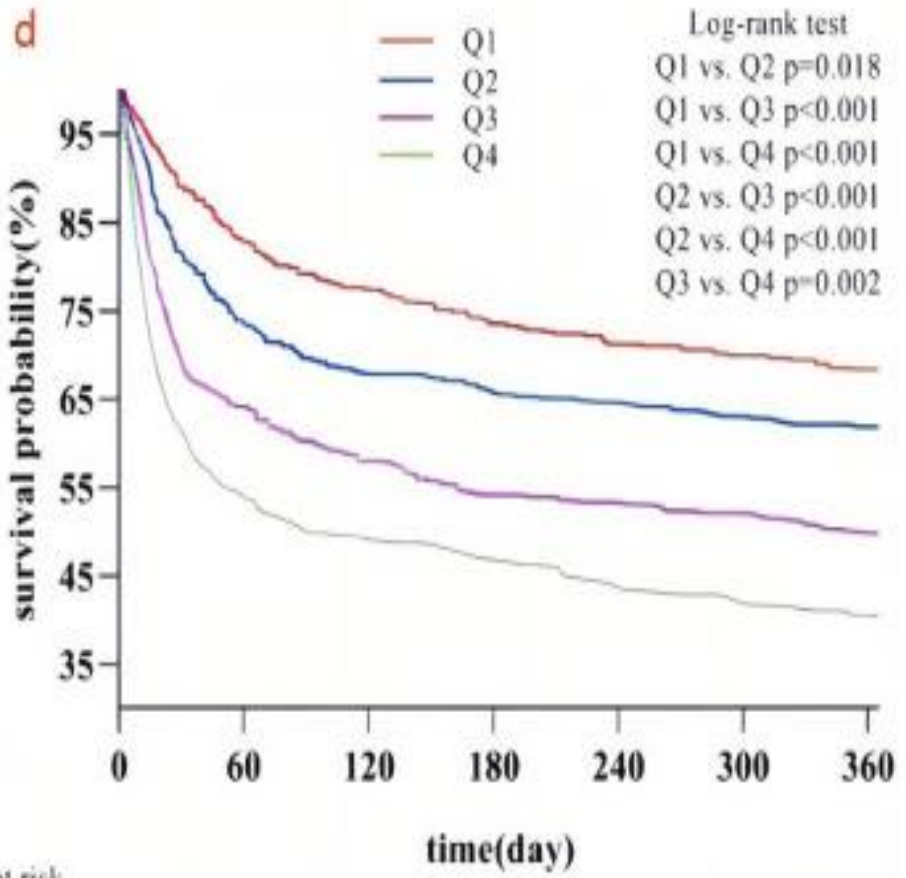
N/LPRR Kaplan-Meier survival curve for 30-day mortality



Number at risk

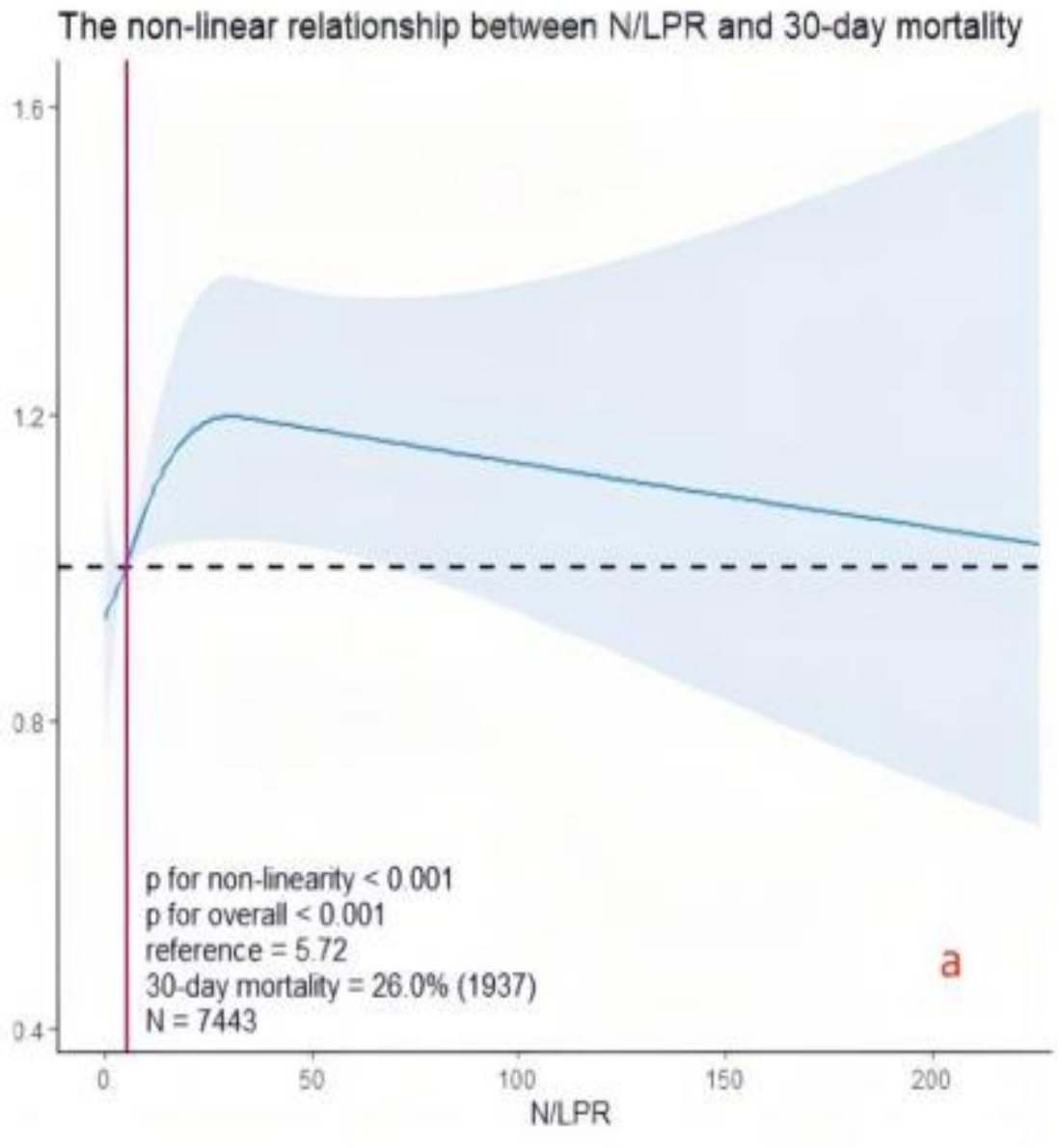
Q1 group	442	430	419	408	394
Q2 group	441	422	402	378	360
Q3 group	441	403	358	333	310
Q4 group	441	375	318	291	273

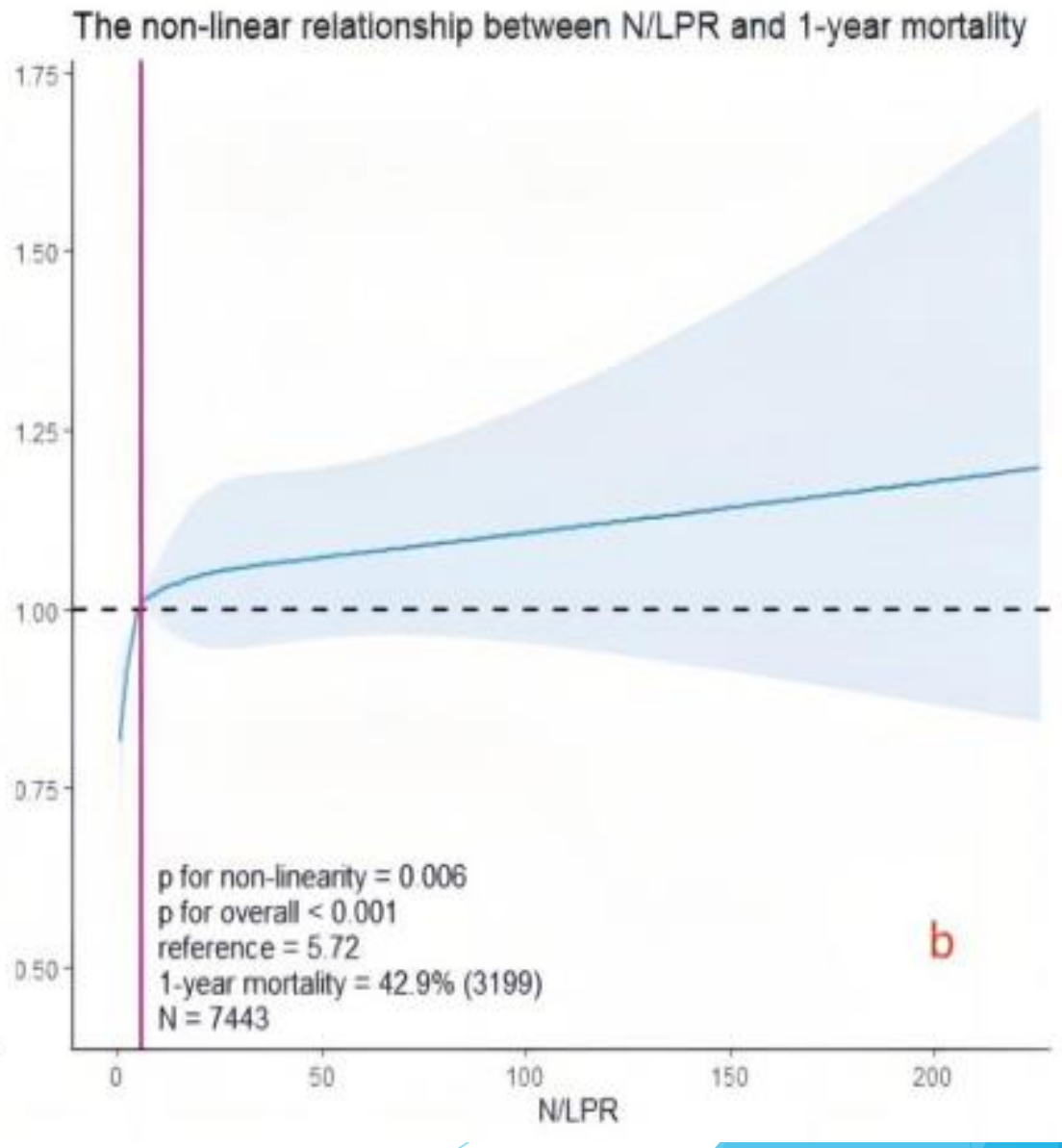
N/LPRR Kaplan-Meier survival curve for 1-year mortality

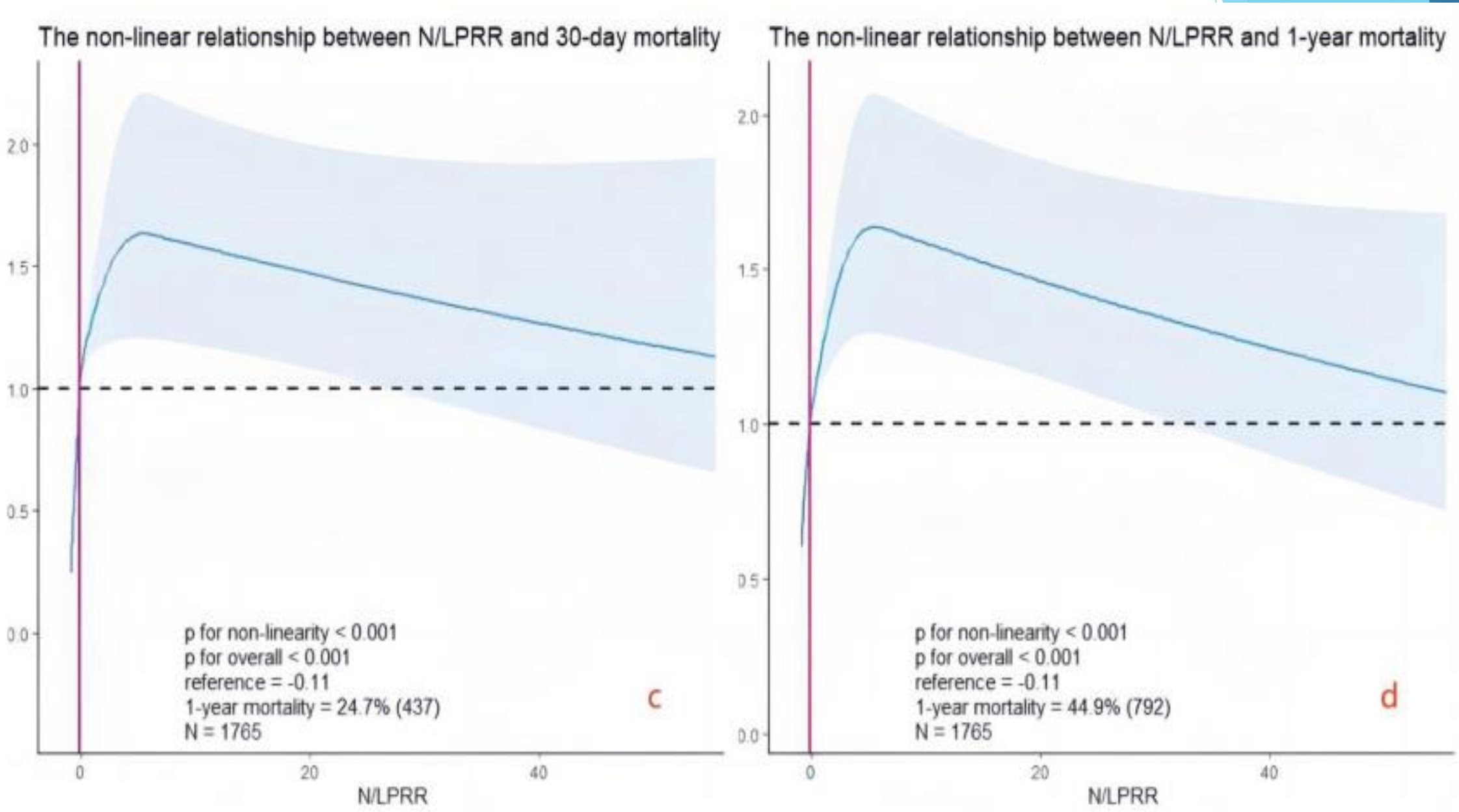


Number at risk

Q1 group	442	366	342	325	315	309	302
Q2 group	441	324	299	290	285	278	273
Q3 group	441	283	256	239	235	230	220
Q4 group	441	237	216	207	192	185	178


The non-linear relationship between N/LPR and 30-day mortality
1.6
1.2
0.8
0.4
p for non-linearity < 0.001
p for overall < 0.001
reference = 5.72
30-day mortality = 26.0% (1937)
N = 7443
a
0
50
100
150
200
N/LPR


The non-linear relationship between N/LPR and 1-year mortality
1.75
1.50
1.25
1.00
0.75
0.50
p for non-linearity = 0.006
p for overall < 0.001
reference = 5.72
1-year mortality = 42.9% (3199)
N = 7443
b
0
50
100
150
200
N/LPR


The non-linear relationship between N/LPRR and 30-day mortality
2.0
1.5
1.0
0.5
0.0
p for non-linearity < 0.001
p for overall < 0.001
reference = -0.11
1-year mortality = 24.7% (437)
N = 1765
c
0
20
40
N/LPRR
The non-linear relationship between N/LPRR and 1-year mortality
2.0
1.5
1.0
0.5
0.0
p for non-linearity < 0.001
p for overall < 0.001
reference = -0.11
1-year mortality = 44.9% (792)
N = 1765
d
0
20
40
N/LPRR

Discussion

- This study demonstrated that high N/LPR and N/LPRR in patients with sepsis had a higher risk of all-cause mortality. N/LPRR exhibited a more vital classification ability for long-term mortality risk than N/LPR. Our results confirmed the feasibility of using N/LPR and its dynamic changes to estimate the death risk in sepsis patients over short-term and long-term periods.

- N/LPR has gained attention for its ability to reflect the balance between systemic inflammation and coagulation in acute illnesses [15,16,17, 23]. Numerous studies have identified NLR as a reliable risk factor for poor prognosis in patients with sepsis [24,25,26,27].

- In the early stages of sepsis, pathogenic microorganisms and inflammatory mediators delay neutrophil apoptosis and accelerate their release, leading to a significant increase in highly phagocytic neutrophils in circulation [28, 29]. These neutrophils not only target pathogens but also release cytokines and lysosomal substances, contributing to immune suppression and inflammatory damage.

- Moreover, many pathogens and toxins induce lymphocyte apoptosis and inhibit lymphocyte proliferation, potentially linked to changes in endogenous cortisol and catecholamine levels [30, 31]. NLR reflects the balance between neutrophils and lymphocytes [32], but it does not account for coagulation dysfunction.

- Sepsis frequently leads to varying degrees of thrombocytopenia [33], and while the exact mechanisms behind sepsis-related thrombocytopenia remain unclear 34, 35), it is believed that sepsis induces hypercoagulability, microthrombosis, and platelet destruction.

Discussion

- Sepsis-related toxins can directly inhibit bone marrow function, promoting disseminated intravascular coagulation.

- Sepsis is characterized by fluctuating inflammatory and coagulation responses throughout the disease course. N/LPRR (magnitude and direction) captures the ongoing trends of deterioration or improvement in the inflammation-coagulation balance, while baseline N/LPR only represents a single-time status. Dynamic monitoring of inflammatory and coagulation markers provides a more accurate prediction of patient mortality.

- A significant increase in NLR reflects the severity of critical illness, stress, and inflammation [39]. The trends in neutrophil, lymphocyte, and NLR changes, as observed in repeated routine blood tests, offer valuable prognostic insight for patients with bloodstream infections [26].

- Regarding platelet dynamics, persistent or acquired thrombocytopenia shortly after ICU admission is significantly associated with in-hospital or 28-day mortality in patients with sepsis [41, 42]. N/LPRR uniquely captures the dynamic interplay between inflammation and coagulation. Positive N/LPRR changes may indicate worsening inflammation and coagulopathy, whereas negative changes suggest improvement in both inflammation and coagulation, indicating a better prognosis. Therefore, tracking both N/LPR values and trends offers a promising approach to understanding disease progression and improving patient outcomes in critical illnesses.

Discussion

- Koo et al. demonstrated a strong correlation between N/LPR and the occurrence of acute renal injury and all-cause mortality in cardiac surgery patients [23]. An independent relationship between N/LPR and in-hospital mortality was also found in septic patients with concurrent kidney injury [15].

- Additionally, two small retrospective studies reported that significantly elevated N/LPR levels effectively predict 28-day mortality in ARDS and septic patients [16, 17], findings that align with our results. However, prior studies mainly focused on baseline N/LPR levels, and the acute dynamic changes in N/LPR may introduce bias in its predictive value. This study highlights the clinical significance of N/LPRR for adverse outcomes, differentiating it from earlier research.

- The non-linear relationship between N/LPR, N/LPRR, and mortality likely arises from the dynamic interaction between inflammation and coagulation during sepsis progression.

- In the low-to-moderate N/LPR range (compensated state), an elevated N/LPR reflects mild neutrophil hyper activation combined with lymphocyte/PLT consumption [35]. When the immune compensation threshold (critical N/LPR value) is surpassed, excessive inflammatory activation and severe coagulopathy accelerate organ damage, significantly increasing mortality.

Discussion

- N/LPRR effectively captures the dynamic interplay between coagulation and inflammation, reflecting disease progression. The low-risk range (N/LPRR < − 0.11) suggests immune suppression or partial compensation, with manageable inflammatory responses and coagulopathy. Conversely, the high-risk range (N/LPRR > − 0.11) indicates excessive neutrophil activation, lymphocyte depletion, and platelet dysfunction, fostering a vicious cycle of inflammation and hypercoagulability. This phase resembles the immunoparalysis observed in the terminal stage of sepsis-induced DIC [14].

- The subgroup analysis results reinforce the robustness of the findings. Notably, in septic patients with CHF, the association between elevated N/LPRR and 30-day mortality is even more. These patients often experience rapid clinical deterioration over short time periods. The underlying mechanism may involve synergistic amplification between inflammation/coagulation imbalance and CHF pathophysiology. CHF inherently predisposes patients to a chronic inflammatory state [45,46,47].

- Neutrophil-driven systemic inflammation and lymphocyte involvement in physiological stress responses [50] collectively elevate NLR, and accelerate myocardial destruction/maladaptive remodeling in patients with CHF. Notably, NLR elevation correlates with left ventricular functional decline [45, 51,52,53].

Discussion

- Emerging data suggest that platelet count reduction serves as a critical prognostic marker in CHF with preserved ejection fraction, strongly associated with disease progression [54]. Comorbidities such as atrial fibrillation, obesity, and diabetes induce platelet dysfunction, altering platelet size, granularity, and reactivity [55,56,57,58,59].

- This dysfunction may exacerbate inflammatory cascades, oxidative stress, and endothelial dysregulation. In severe infectious conditions, the intrinsic inflammatory susceptibility of patients with CHF likely amplifies NLR's prognostic value for short-term outcomes, positioning it as a robust clinical parameter for risk stratification in this vulnerable cohort. Although anti-inflammatory therapy still faces challenges in CHF management, we cannot deny the necessity of anti-inflammatory treatment for CHF patients [60, 61], regardless of sepsis comorbidity. Future research should focus on developing personalized anti-inflammatory strategies through high-quality clinical studies, which requires deeper mechanistic understanding of inflammatory pathways in CHF.

Discussion

- Serial monitoring of N/LPR during hospitalization offers substantial clinical value for critically ill patients. Compared to N/LPR, NLR, PLT, and SOFA scores, N/LPRR demonstrated superior and independent predictive ability for all-cause mortality.

- integrating N/LPRR with existing scoring systems (e.g., SOFA) offers robust support for bedside decision-making. N/LPR and SOFA focus on different aspects. N/LPR reflects changes in inflammation and coagulation, while SOFA assesses overall organ function. Using them together provides a more comprehensive evaluation of a patient's disease status.

- A single indicator may not fully capture a patient's complex pathophysiology. Dynamic monitoring of N/LPR and SOFA score can reflect real-time patient condition changes, and timely treatment adjustments, thus enhancing clinical management. Further prospective studies are required to validate and refine the clinical utility of N/LPRR, enhancing its predictive accuracy and practical relevance.

Conclusion

Baseline N/LPR and N/LPRR are associated with the risk of all-cause mortality in septic patients. N/LPRR provides more meaningful insights into identifying individuals at higher risk of adverse outcomes. Prospective studies are needed to explore the causal relationship between N/LPR and N/LPRR and all-cause mortality.

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Thank you