



## Systemic Immune Inflammatory (SII) Index in Evaluating the Severity of Multitrauma Patients in the Emergency Department

### Acil Serviste Multitravma Hastalarının Şiddetinin Değerlendirilmesinde Sistemik İmmün İnflamatuvar (SII) İndeksi

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#### ABSTRACT

**Aim:** In the emergency department, healthcare providers face the critical task of assessing and managing patients with multitrauma, a condition characterized by multiple injuries sustained simultaneously. In this study, we evaluated the power of the systemic immune inflammatory index in predicting the prognosis and severity of patients admitted to the emergency department with multitrauma

**Material and Method:** Patients aged 18 years and older who presented to the adult emergency department of the hospital and were diagnosed with Multitrauma 1 January 2022 and 31 December 2022 were included in the study. Demographic characteristics (age and gender), initial laboratory test results including neutrophil (N), lymphocyte (L), and platelet counts, as well as NLR, PLO and SII will be calculated according to laboratory results; (NLR=neutrophil count / lymphocyte count ratio; PLR=platelet count / lymphocyte count ratio; SII=platelet count x neutrophil count / lymphocyte count ratio), hospital admission or intensive care unit (ICU) admission status, and patient outcomes were recorded from the medical records.

**Results:** According to ROC analysis, NLR, PLR and SII parameters were statistically significant for the distinction between hospitalization and discharge (P<0.001, P:0.016 and P<0.001, respectively). When the data were categorized according to the cut-off values determined in the ROC analysis, NLR over 2.84 and SII over 777 were found to be significant for hospitalization according to the Chi-square analysis, while PLR over 108 was not significant (respectively P. <0.001, P:0.111 and P<0.001)

**Conclusion:** These markers provide valuable insights into the systemic inflammatory response and have the potential to aid in risk stratification, prognosis assessment, and treatment decision-making. However, further research is warranted to validate their utility in diverse patient populations and clinical scenarios.

**Keywords:** Systemic immune inflammatory index, multitrauma, early alert, emergency medicine

#### ÖZ

**Giriş:** Acil serviste, sağlık hizmeti sağlayıcıları, aynı anda birden fazla yaralanma ile karakterize edilen bir durum olan multitravmalı hastaları değerlendirme ve yönetme gibi kritik bir görevle karşı karşıyadır. Bu çalışmada acil servise multitravma ile başvuran hastaların prognozunu ve ciddiyetini öngörmeye sistemik immün inflamatuvar indeksin gücünü değerlendirdik.

**Gereç ve Yöntem:** Hastanenin erişkin acil servisine başvuran ve 1 Ocak 2022 ile 31 Aralık 2022 tarihlerinde Çoklu Travma tanısı alan 18 yaş ve üstü hastalar çalışmaya alındı. Demografik özellikler (yaş ve cinsiyet), nötrofil (N), lenfosit (L) ve trombosit sayılarını içeren ilk laboratuvar test sonuçları ile NLR, PLO ve SII laboratuvar sonuçlarına göre hesaplanacaktır; (NLR = nötrofil sayısı / lenfosit sayısı oranı; PLR = trombosit sayısı / lenfosit sayısı oranı; SII = trombosit sayısı x nötrofil sayısı / lenfosit sayısı oranı), hastaneye yatış veya yoğun bakım ünitesine (YBÜ) yatış durumu ve hasta sonuçları kaydedildi. tıbbi kayıtlar.

**Bulgular:** ROC analizine göre NLR, PLO ve SII parametreleri hastaneye yatış ve taburculuk ayrımında istatistiksel olarak anlamlı bulundu (sırasıyla P<0.001, P:0.016 ve P<0.001). Veriler ROC analizinde belirlenen cut-off değerlerine göre kategorize edildiğinde Ki-kare analizine göre NLO 2,84 üzeri ve SII 777 üzeri anlamlı bulunurken PLO 108 üzeri anlamlı bulunmadı (sırasıyla P <0,001, P:0,111 ve P<0,001)

**Sonuç:** Bu belirteçler, sistemik inflamatuvar cevaba ilişkin değerli bilgiler sağlar ve risk sınıflandırması, prognoz değerlendirmesi ve tedavi kararı vermeye yardımcı olma potansiyeline sahiptir. Bununla birlikte, çeşitli hasta popülasyonlarında ve klinik senaryolarda faydalarını doğrulamak için daha fazla araştırmaya ihtiyaç vardır.

**Anahtar Kelimeler:** Sistemik immün inflamatuvar indeks, çoklu travma, erken uyarı, acil tıp

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## INTRODUCTION

In the emergency department, healthcare providers face the critical task of assessing and managing patients with multitrauma, a condition characterized by multiple injuries sustained simultaneously (1). Multitrauma cases often present a complex and dynamic clinical scenario, requiring prompt decision-making and swift interventions to save the patient's life. In such high-stress situations, it becomes crucial to identify reliable and efficient methods that can aid in determining the severity of injury and guide appropriate treatment strategies (2).

The time-sensitive nature of multitrauma demands swift and accurate assessment to optimize patient outcomes. Prompt recognition of severe injuries, identification of associated complications, and timely interventions can significantly impact a patient's survival and long-term functional recovery (1). Clinicians and researchers continually seek innovative tools and markers that can aid in the rapid evaluation of multitrauma patients, providing valuable insights into their overall condition and guiding appropriate clinical management (3).

One promising avenue of investigation in assessing the severity of multitrauma patients involves the use of the Systemic Immune Inflammatory (SII) index (4). The SII index is a derived parameter that integrates peripheral blood cell counts, including platelet, lymphocyte, and neutrophil counts. It has been proposed as a potential marker of systemic inflammation and immune response, with emerging evidence suggesting its utility in various disease states, including cancer, infectious diseases, and cardiovascular disorders (5).

The rationale behind exploring the application of the SII index in multitrauma cases lies in its ability to provide insights into the intricate relationship between inflammation, immune response, and trauma severity (6). Trauma triggers a cascade of immune and inflammatory processes that play a vital role in determining the extent of tissue damage, organ dysfunction, and overall prognosis. By leveraging the SII index, clinicians can potentially assess the severity of systemic inflammation and immune dysregulation, thus aiding in risk stratification and therapeutic decision-making for multitrauma patients (7).

The critical need for swift assessment and intervention in multitrauma cases, exploring the potential utility of the SII index in evaluating trauma severity becomes essential. In this study, we evaluated the power of the systemic immune inflammatory index in predicting the prognosis and severity of patients admitted to the emergency department with multitrauma.

## MATERIAL AND METHOD

### Study Design and Setting

This was a single-center retrospective cross-sectional study conducted in the emergency medicine clinic of a tertiary care hospital located in a metropolitan area with an approximate population of 4.5 million. The study was carried out with the permission of Izmir Katip Çelebi University Non-Interventional Clinical Research Ethics Committee (Decision No: 0050, Date: 23.02.2023).

### Study Population

Patients aged 18 years and older who presented to the adult emergency department of the hospital and were diagnosed with Multitrauma (such as in-vehicle traffic accidents and out-of-vehicle traffic accidents, falling from a height, loss of limb, assault etc.) 1 January 2022 and 31 December 2022 were included in the study. Patients under the age of 18 and Cases under the age of 18, Burns, Persons with a history of cancer, autoimmunity, allergy, inflammatory or infectious disease in the last 3 months, Patients with missing data, and Unable to follow-up (cases referred or refused treatment) were excluded from the study.

### Data Collection and Processing

Demographic characteristics (age and gender), initial laboratory test results including neutrophil (N), lymphocyte (L), and platelet counts, as well as NLR, PLO and SII will be calculated according to laboratory results; (NLR=neutrophil count / lymphocyte count ratio; PLR=platelet count / lymphocyte count ratio; SII=platelet count x neutrophil count / lymphocyte count ratio), hospital admission or intensive care unit (ICU) admission status, and patient outcomes were recorded from the medical records.

### Outcome Measures

To determine the superiority of NLR, SII and PLR values in diagnosing meningitis and encephalitis, as well as predicting the severity and clinical outcomes of the disease, these parameters were compared with other variables that could be associated with disease severity and clinical outcomes. Additionally, N/L ratio, SII values, and other associated parameters were compared between the group with mortality and the group who survived in both diseases.

### Data Analysis

Data obtained in the study were analyzed using IBM SPSS Statistics for Macos, Version 26.0. Armonk, NY: IBM Corp. Categorical variables were expressed as numbers and percentages, while numerical variables were expressed as mean and standard deviation when presenting the descriptive statistics. Shapiro-Wilk test was used as the normality test. Since the data did not follow a normal distribution, Mann-Whitney U test was used for comparisons between two group means. Chi-square test was used for comparisons of categorical variables. A p-value of <0.05 was considered statistically significant. Results were presented with a 95% confidence interval.



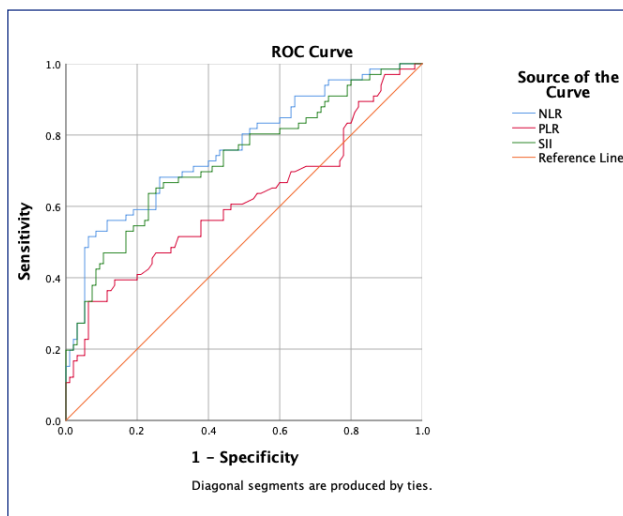
## RESULTS

A total of 179 patients were included in the study. The mean age of the patients was  $37 \pm 16$ . Thirty-five (20%) of the patients were female and 144 (80%) were male. While 95 (53%) patients were discharged from the emergency room, 66 (37%) patients were admitted to the service and 18 (10%) patients to the intensive care unit. Eight of the patients included in the study died. The average of the laboratory results of the patients is presented in **Table 1**.

	N	Minimum	Maximum	Mean	Std. Deviation
Neutrophil	179	2.51	40.46	8.5	5.3
Lymphocyte	179	.350	6.840	2.4	1.2
Platelet	179	51	443	260	70
NLR	179	.6	56.2	5.6	7.6
PLR	179	18.0	700.0	142	103
SII	179	69.4	14208.0	1453	2015
Age	179	17	92	37	16

According to ROC analysis, NLR, PLR and SII parameters were statistically significant for the distinction between hospitalization and discharge ( $P < 0.001$ ,  $P = 0.016$  and  $P < 0.001$ , respectively). When the data were categorized according to the cut-off values determined in the ROC analysis, NLR over 2.84 and SII over 777 were found to be significant for hospitalization according to the Chi-square analysis, while PLR over 108 was not significant (respectively  $P < 0.001$ ,  $P = 0.111$  and  $P < 0.001$ ) (**Table 2**)

	AUC	Sensitivite	Spesifite	PPD	NPD	P
NLR >2.8	0.762	71	64	58	76	<0.001
PLR >108	0.611	59	54	45	65	0.111
SII >777	0.732	68	68	59	76	<0.001

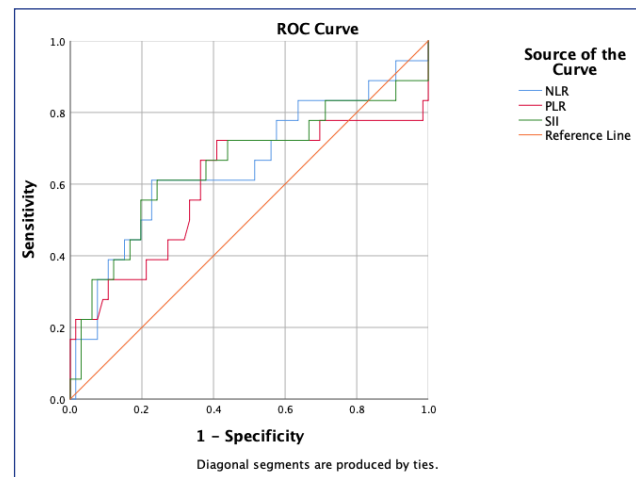


**Figure 1.** ROC analysis of NLR, PLR and SII in predicting ICU and service hospitalisation

According to the ROC analysis, while NLR and SII parameters were statistically significant for the distinction between hospitalization and ICU ( $P = 0.045$  and  $P = 0.047$ , respectively), PLR was not significant ( $p = 0.187$ ).

When the data were categorized according to the cut-off values determined in the ROC analysis, according to the Chi-square analysis performed, NLR above 9.5, PLR above 156 and SII above 1397 were found to be significant for ICU (Respectively  $P = 0.002$ ,  $P = 0.021$ ,  $P = 0.028$ ) (**Table 3**).

	AUC	Sensitivite	Spesifite	NPD	PPD	P
NLR >9.5	0.655	61	77	42	88	0.002
PLR >156	0.602	67	64	33	88	0.021
SII >1397	0.653	76	62	32	87	0.028



**Figure 2.** ROC analysis of NLR, PLR and SII in predicting mortality

In the ROC analysis performed to evaluate the success of the tests in predicting mortality, it was seen that NLR, PLR and SII failed to predict mortality ( $p = 0.235$ ,  $p = 0.831$  and  $p = 0.507$ , respectively).

## DISCUSSION

The aim of our study was to investigate the predictive value of blood count-derived inflammatory markers and systemic immune-inflammation indices in various clinical outcomes. Let's discuss and comment on our results, incorporating the references provided.

In our study, we observed that elevated levels of neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and systemic immune-inflammation index (SII) were associated with adverse outcomes, such as longer hospital stays and increased risk of complications. These findings align with previous research (8-10) and highlight the potential clinical utility of these markers as prognostic indicators. However, it is important to note that our study had a relatively small sample size, which may limit the generalizability of the findings.

In line with studies by Calleja et al. (2020) and Ciechanowicz et al. (2020), our findings emphasize the importance of effective information transfer and comprehensive management strategies for multitrauma patients. Early identification of injuries, such as completely transected common hepatic duct injury (3), is crucial for successful management and improved patient outcomes. Our study contributes to the understanding of the systemic immune response to trauma, which plays a pivotal role in tissue damage and organ dysfunction (4, 7).

Furthermore, the association between inflammatory markers and clinical outcomes extends beyond trauma-related conditions. Studies by Esenboğa et al. (2022) and Simon et al. (2016) demonstrate the predictive value of systemic immune-inflammation indices and plasma brain-derived neurotrophic factor levels in predicting outcomes in cardiovascular and traumatic brain injury patients, respectively (5,11).

While our study adds to the existing literature, it is essential to acknowledge the limitations. The retrospective nature of our study introduces the possibility of bias, and prospective studies with larger cohorts are needed to establish a causal relationship between inflammatory markers and clinical outcomes (12).

The systemic immune-inflammation index (SII), a marker combining platelet, neutrophil, and lymphocyte counts, has been investigated in different clinical settings. Studies have shown its prognostic value in pediatric burned patients (13), as well as in patients with acute appendicitis (14), gastric cancer (15), urologic cancers (16), and COVID-19 (17-19). These studies demonstrate the broad applicability of SII as a prognostic marker across different disease entities.

Additionally, the neutrophil-lymphocyte ratio (NLR), another inflammatory marker, has been extensively studied in various clinical conditions. It has been associated with adverse outcomes in polytrauma patients (2), thoracic trauma patients (8), and patients with traumatic brain injury (9). Moreover, the platelet-lymphocyte ratio (PLR) has been investigated in patients with hip fracture (10) and primary percutaneous coronary intervention (5), showing its potential prognostic value in these populations.

The relevance of inflammatory markers in trauma extends beyond their predictive value. Inflammatory responses play a pivotal role in the pathophysiology of trauma and surgery, affecting the systemic inflammatory response syndrome (SIRS) and subsequent organ dysfunction. Understanding the mechanisms underlying SIRS and the protective strategies to mitigate its detrimental effects is essential for improving patient outcomes. Margraf et al. provide a comprehensive overview of the mechanisms and protective measures against SIRS after surgery (20).

In summary, our study provides valuable insights into the potential clinical utility of blood count-derived inflammatory markers and systemic immune-inflammation indices in predicting clinical outcomes in various conditions. These markers have the potential to aid in risk stratification, prognosis assessment, and treatment decision-making. However, further research is warranted to validate their utility in diverse patient populations and clinical scenarios.

### Limitation

The retrospective nature of our study introduces inherent limitations, including the possibility of selection bias and incomplete or missing data. The reliance on medical records and data collected for clinical purposes may lead to inconsistencies and inaccuracies in the variables analyzed. Moreover, the retrospective design limits our ability to establish causality between inflammatory markers and clinical outcomes. Prospective studies with standardized data collection protocols are needed to overcome these limitations and provide more robust evidence.

## CONCLUSION

This study contributes to the growing body of evidence supporting the clinical utility of blood count-derived inflammatory markers and systemic immune-inflammation indices as prognostic indicators in various clinical conditions. These markers provide valuable insights into the systemic inflammatory response and have the potential to aid in risk stratification, prognosis assessment, and treatment decision-making. However, further research is warranted to validate their utility in diverse patient populations and clinical scenarios.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was carried out with the permission of Izmir Katip Çelebi University Non-Interventional Clinical Research Ethics Committee (Decision No: 0050, Date: 23.02.2023).

**Informed Consent:** Informed consent form did not obtained from the participants due to the nature of the study.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

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**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.





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