

REVIEW ARTICLE

Neutrophil to Lymphocyte Ratio as a Predictive Factor of Unfavorable Outcomes in Traumatic Spinal Cord Injury: A Systematic Review and Meta-analysis

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Abstract: **Introduction:** There are a number of biomarkers connected to inflammation that affect spinal cord injury (SCI) outcomes. This systematic review and meta-analysis was conducted to evaluate the prognostic value of the Neutrophil-to-lymphocyte ratio (NLR) in patients diagnosed with traumatic SCI. **Methods:** Observational studies evaluating the association between baseline NLR and severity or neurological improvement in traumatic SCI patients were systematically identified using Medline, Embase, Scopus, and Web of Science databases on March 4, 2025. The risk of bias among the included studies was assessed using the National Heart, Lung, and Blood Institute (NHLBI) tool. A random-effects model was employed for meta-analyses. Effects sizes were reported as odds ratios (ORs) or standardized mean difference (SMD), along with their 95% confidence intervals (CIs). **Results:** Six retrospective cohort studies involving 1,564 participants were included, with five eligible for meta-analysis. Blood samples were collected within 72 hours of admission. Meta-analysis showed that patients without neurological improvement had significantly higher NLR values (SMD: 0.98; 95% CI: 0.08–1.87; $I^2 = 94.36\%$). Additionally, elevated NLR was independently associated with no neurological improvement (adjusted OR: 1.12; 95% CI: 1.06–1.17; $I^2 = 0.04\%$). Qualitative synthesis further indicated that higher NLR values were consistently associated with greater injury severity in acute traumatic SCI. **Conclusion:** Elevated NLR is associated with greater injury severity and poorer neurological recovery in patients with acute traumatic SCI. These findings suggest that NLR may serve as a useful early prognostic biomarker in the clinical assessment of mentioned patients.

Keywords: Spinal Cord Injuries; Biomarkers; Prognosis; Trauma Severity Indices; Neurological Rehabilitation

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1. Introduction

Spinal cord injury (SCI) represents a significant global health burden, contributing to substantial mortality, profound disability, diminished quality of life, and considerable economic repercussions (1). Consequently, prompt assessment of injury severity and prognosis is critical for predicting neurological outcomes (2, 3). Current methods for assessing the severity of SCI include electrophysiological testing, magnetic res-

onance imaging (MRI), and the American Spinal Injury Association (ASIA) Impairment Scale. However, these approaches present challenges, particularly in the acute phase. Spinal shock can compromise the reliability of ASIA grading. Meanwhile, MRI may not always be accessible, might lack sufficient detail on secondary injury, or could be contraindicated for patients with metal implants. These limitations highlight the critical need for easily obtainable and reliable biomarkers to facilitate early assessment of SCI severity and prognosis (4-7). SCI starts with acute mechanical damage, which is the main cause of the injury. This is followed by a secondary inflammatory phase that starts soon after the injury and can linger for weeks or even months, making it much harder for the neural tissue to heal. There are a number of biomarkers connected to inflammation that affect SCI outcomes (8, 9). During secondary SCI, neutrophils, lymphocytes, platelets, and monocytes accumulate at the lesion site. Neutrophils are typically early responders, indicative of acute

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inflammation, while lymphocytes appear later. The NLR, a readily calculable parameter from routine blood counts, is considered by some studies to be a potential prognostic marker for SCI patients' recovery and long-term outcomes (4, 10, 11). However, most studies investigating NLR in SCI have been conducted at single centers with limited sample sizes. This significantly hinders the generalizability of their findings. Furthermore, the results across these studies are inconsistent; some demonstrate strong correlations between NLR and neurological outcomes, while others report weak or no associations (4, 12).

Given these limitations and the variability in results, a systematic review and meta-analysis is essential. This approach would provide a pooled estimate, yielding more robust and generalizable information regarding the prognostic significance of NLR in SCI. Additionally, it would allow for an investigation into potential reasons for the observed discrepancies across studies. This systematic review and meta-analysis was performed to investigate the association between NLR and outcomes in traumatic SCI, including neurological improvement and the severity of SCI.

2. Methods

2.1. Study design and setting

This systematic review and meta-analysis was developed and executed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (13). The study protocol has been registered in PROSPERO with the registration number CRD420251086100.

This study aimed to evaluate the prognostic value of NLR in predicting unfavorable outcomes after traumatic SCI. The PIT framework was organized in the following manner: The patient/problem/population (P) encompassed humans with traumatic spinal cord injury; the index test (I) pertained to blood NLR; the target condition (T) encompassed the SCI severity according to ASIA impairment scale (AIS) (14). Briefly, the AIS scale is widely used to categorize patients into complete injury, incomplete injury, and normal (grades A to E) after the resolution of spinal shock.

2.2. Search strategy

A systematic search was executed across the Medline (via PubMed), Embase, Scopus, and Web of Science databases on March 4, 2025. The search keywords were derived from MeSH and Emtree terms related to 'neutrophil-to-lymphocyte ratio' and 'spinal cord injury', along with their synonyms. The search strategy was further refined through expert consultation. A manual search was conducted using Google and Google Scholar, and references from relevant articles were analyzed to recover any potentially overlooked studies. Details of the queries are provided in Supplementary Material 1. Furthermore, grey literature, citation tracking, and reference lists from included studies were scrutinized to identify any potentially missing research. There were no date

limitations or language restrictions in this search strategy.

2.3. Eligibility criteria

All human studies assessing NLR in traumatic SCI were included, regardless of publication time or language. Studies were eligible if they assessed either SCI severity (e.g., complete vs. incomplete injury based on AIS grades) or neurological improvement, defined as an upward change in AIS grade at a specified follow-up (e.g., discharge, 6 months, or 12 months post-injury) compared to initial evaluation after spinal shock resolution. Studies were excluded if they were duplicates, animal studies, editorials, letters to the editor, or reviews. Additionally, studies that did not assess the desired outcomes or lacked NLR measurements, including non-traumatic SCI, were excluded.

2.4. Screening and data collection

The records identified through the systematic search were imported into EndNote X9 (Thomson Reuters, Toronto, ON, Canada), and duplicates were removed. Two reviewers (HZ and AP) independently screened titles and abstracts, followed by full-text screening of potentially eligible articles. Discrepancies were resolved through discussion or adjudication by a third reviewer (MY).

Data extraction was conducted independently and in duplicate using a standardized Excel-based form. Disagreements were resolved by consensus or by involving a third reviewer. Extracted variables included study design, participant demographics, NLR cutoff values, timing of blood sampling and outcome assessment, and outcome definitions. Additional data collected included AIS grades, group-wise means and standard deviations (SDs), diagnostic accuracy data (TP, FP, TN, FN), and effect estimates such as odds ratios (ORs) with 95% confidence intervals (CIs), sensitivity, and specificity. Data were compiled in accordance with PRISMA guidelines (13).

2.5. Risk of bias assessment and certainty of evidence

Risk of bias assessment was independently performed by two independent reviewers utilizing the NHLBI's Quality Assessment tool for Observational, Cohort, and Cross-Sectional Studies checklist. Any discrepancies in ratings were resolved through discussion with a third reviewer.

The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) (25) was used to evaluate the certainty of evidence for neurological improvement. The evidence is rated according to five key domains: risk of bias, inconsistency (large differences in effect estimates may lower confidence), indirectness (how directly the evidence applies to the research question), imprecision (wide confidence intervals reduce precision), and publication bias. In the case of a disagreement, the conflict was resolved through discussions with a third researcher.

2.6. Statistical analysis

All statistical analyses were performed with STATA 17.0 (StataCorp LLC, College Station, TX, USA). The data intended for synthesis comprised three categories: standardized mean differences (SMD) of no change versus improvement depending on ASIA level (utilizing Hedges' g , which does not necessitate unit equalization across studies), prognostic accuracy data (TP, TN, FP, and FN), and unadjusted/adjusted ORs. The minimum number of studies necessary for synthesis was three to conduct pooled analyses.

Although the adjusted odds ratios were derived from models with slightly different covariate sets, all of the studies included adjustments for the core prognostic variables of age, sex, and initial AIS grade. This consistency supports the validity of pooling. A random-effects model was employed due to methodological heterogeneity among studies. In case that meta-analysis was infeasible due to insufficient data, a qualitative overview of the studies' results was provided. Subgroup or sensitivity analyses were not possible due to insufficient number of studies. The I^2 statistic and chi-squared test were employed to evaluate statistical heterogeneity, with $p < 0.1$ or $I^2 > 50\%$ signifying substantial heterogeneity. Publication bias was evaluated using funnel plots and modified Egger's test proposed by Doleman et al. (11).

3. Results

3.1. Search results

The systematic search resulted in 119 records. After removing duplicates, 77 records were screened. Following the primary screening, 51 papers were assessed for eligibility and underwent full-text screening. Ultimately, 6 studies were included in this systematic review, 5 of which were included in the meta-analysis (4-6, 10, 12, 15) (Figure 1).

3.2. Study characteristics

The included studies consisted of six retrospective cohort studies; all conducted in China and published between 2020 and 2024. Collectively, these studies examined data from 1,564 participants (76% male), with a mean age of 51.03 years, excluding the study that did not report age and sex data. Blood samples were collected within 72 hours of hospital admission. A detailed summary of the study characteristics is presented in Table 1.

3.3. Prognostic value of NLR in predicting the severity of SCI

Several studies have identified higher NLR values on admission (within 8 hours post-injury) as a strong predictor of injury severity in patients with acute SCI (4, 6, 10, 15). Patients with complete SCI (AIS grade A after spinal shock) exhibited markedly elevated NLR levels compared to those with incomplete injuries (AIS B-D) (4). An NLR above 10 was found to be indicative of complete SCI, with a sensitivity of 88.5% and a specificity of 48.5% (4).

Another study classified complete AIS as A-B, finding that NLR was significantly higher in complete SCI cases than in incomplete (6). NLR could predict AIS A-B after the spinal shock with 79% sensitivity and 57% specificity (6). Additionally, patients with greater maximum spinal cord compression and greater spinal canal compromise had significantly higher NLR levels, further supporting its role in predicting initial severity (5, 12).

Another study demonstrated that NLR at admission was strongly associated with AIS grades at discharge, with higher NLR values indicating more severe injuries (AIS A-C) (OR = 1.14; 95% CI: 1.08, 1.20) (10). This association remained significant even after adjusting for age, sex, mean arterial pressure, spinal surgery, mechanism of injury, level of cord injury, and initial AIS grade (adjusted OR = 1.13; 95% CI: 1.01, 1.26) (10). Similarly, higher initial NLR values independently predicted more severe SCIs (AIS A-C) at six months post-injury (adjusted OR = 1.08; 95% CI: 1.02, 1.15) (15).

3.4. Prognostic value of NLR in predicting neurological improvement after SCI

In a meta-analysis of three studies comprising 458 patients with SCI, NLR was compared between 203 patients with no improvement and 255 patients who showed improvement (4, 5, 12). Injury to sampling interval ranged between 7 to 72 hours post-injury, and improvement was defined as a better AIS level in 6 to 12 months compared to initial levels. Results showed that NLR was significantly higher in patients without improvement (SMD: 0.98, 95% CI: 0.08, 1.87; $I^2=94.36\%$) (Figure 2).

In another meta-analysis of three studies, adjusted ORs were pooled to estimate the independent association between NLR and SCI improvement (5, 10, 12). The analysis revealed a statistically significant association between NLR and no improvement in SCI patients (Adjusted OR: 1.12, 95% CI: 1.06, 1.17, $I^2=0.03\%$) (Figure 3).

3.5. Risk of bias assessment

Most studies were judged to have an overall low risk of bias. Although all studies were rated as high risk for Criterion 5 (sample size justification), this was not considered a critical flaw in the absence of other major methodological limitations, as per NHLBI guidelines. Studies with fewer than three high-risk or "cannot determine" ratings, and no fatal flaws, were classified as having low overall risk. Only one study (6) was rated as having an overall high risk of bias due to multiple concerns, including unclear exposure measurement and lack of repeated exposure assessment. Some studies had "cannot determine" ratings for blinding of outcome assessors (Criterion 12) and clarity of population and follow-up rates (Criteria 3 and 13). A detailed summary of individual risk of bias assessments is presented in Table 2.

3.6. Publication bias

Funnel plots demonstrated no asymmetry for neurological improvement ($p = 0.880$). Accordingly, there is no evidence of publication bias (Figure 4).

3.7. Certainty of evidence

The certainty of evidence regarding the association between NLR and neurological improvement was rated as moderate. This rating reflects the overall low risk of bias, absence of imprecision, indirectness, or publication bias; however, it was downgraded due to serious inconsistency across the three included studies (Table 3).

4. Discussion

This systematic review and meta-analysis examined the prognostic value of the NLR in acute traumatic SCI. SCI severity and neurological improvement were investigated as distinct outcomes and are discussed separately below.

4.1. NLR and injury severity

Several studies included in this review showed that elevated NLR levels at admission were significantly associated with more severe SCI, as classified by the ASIA Impairment Scale (AIS). Patients with complete injuries (e.g., AIS grade A) consistently exhibited higher NLR values compared to those with incomplete injuries. These findings suggest that NLR may serve as a supplementary diagnostic biomarker for early assessment of injury severity, especially in resource-limited or emergency settings where MRI may not be readily available. Furthermore, He et al. (2023) and Liu et al. (2024) demonstrated that NLR correlated with radiologic markers of severity, such as maximum spinal cord compression (MSCC), maximum canal compromise (MCC), and intramedullary lesion length (IMLL), reinforcing its potential role in evaluating acute inflammatory injury burden (5, 12). From a biological perspective, elevated NLR likely reflects an imbalance between neutrophil-driven inflammation and lymphocyte-mediated regulation, both of which contribute to early tissue damage.

4.2. NLR and neurological improvement

Higher NLR levels were associated with lower likelihood of neurological improvement over time. The meta-analysis of adjusted ORs indicated that each unit increase in NLR was associated with a 12% increase in the odds of poor recovery. Notably, all included models were adjusted for age, sex, and initial AIS grade—key prognostic confounders—enhancing the internal validity of pooled results. Statistical heterogeneity was low. In contrast, the comparison of raw NLR values between improved and non-improved groups showed a significant effect size but high heterogeneity, likely reflecting variation in study design, sampling timing, and definitions of neurological improvement. Despite this, the direction of association remained consistent.

The study by Zhao et al. (2020) reported that each unit increase in NLR is related to a 9% increase in the odds of an adverse outcome in cervical traumatic SCI patients (15). Similarly, Chen et al. (2024) indicated that higher NLR levels at admission were predictive of worse neurological recovery and increased risk of complications (4). He et al. (2023) identified NLR within 72 hours of admission as a key predictor of injury severity and neurological recovery at six months, in conjunction with MRI-based parameters such as maximum spinal cord compression (MSCC) and maximum canal compromise (MCC) (12). Additionally, Liu et al. (2024) demonstrated that NLR, combined with MRI variables such as intramedullary lesion length (IMLL) and MCC, increases predictive accuracy for long-term neurological outcomes in cervical traumatic SCI patients (5). A possible explanation for these associations is that NLR indicates the balance between pro-inflammatory neutrophil activity and immune-modulatory lymphocyte function (16). Neutrophils, as primary responders to injury, release inflammatory cytokines and reactive oxygen species (ROS) that can exacerbate neuronal damage, while lymphocytes play a crucial role in immune regulation and tissue repair (17, 18). A higher NLR may indicate an exaggerated inflammatory response and immune imbalance, leading to poorer neurological recovery and increased secondary injury (19, 20).

Accurate initial evaluation of traumatic SCI severity is crucial for ensuring timely medical interventions and predicting patient outcomes. Currently, MRI and the AIS are the standard diagnostic tools, but both have limitations (21). MRI may not always be quickly accessible, especially in emergency situations or in environments with limited resources (5). AIS grading can be affected by spinal shock, reducing its reliability for early assessments (12).

Our findings, along with those of He et al. and Liu et al., indicate that NLR could be a useful biomarker to complement existing diagnostic methods (5, 12). Liu et al. demonstrated that NLR, in combination with MRI parameters such as intramedullary hemorrhage and IMLL, showed higher predictive accuracy for AIS grade conversion compared to each marker separately (5). Since NLR is easily measured from routine blood tests, cost-effective, and quickly available, it serves as an efficient tool for early risk assessment in acute traumatic SCI patients.

In addition to its diagnostic value, NLR has significant prognostic implications for long-term neurological recovery in traumatic SCI patients. The strong correlation between high NLR levels and poor functional outcomes suggests that patients with higher NLR at the time of admission are at a greater risk of prolonged disability, delayed recovery, or permanent neurological damage (4, 15). Specifically, our results indicate that for each unit increase in NLR, the OR of poor prognosis increases by 9%, and the mean NLR in the poor prognosis group is significantly higher compared to the good prognosis group. These findings are supported by Zhao et al., who reported that NLR was an independent predictor

of six-month functional outcomes in cervical traumatic SCI patients (15). Furthermore, Chen et al. demonstrated that higher NLR correlated with worsened neurological recovery and increased risk of complications (4). Finally, He et al. observed that patients with severe AIS grades (A & B) exhibited significantly higher NLR levels compared to those with milder injuries (C–E) (12).

The prognostic significance of the NLR in SCI patients has gained considerable attention in recent years, particularly in the context of predicting recovery outcomes. Our meta-analysis indicates that elevated NLR is associated with a lack of improvement in SCI patients, highlighting the role of neutrophils in exacerbating secondary injury mechanisms.

The pooled data analysis indicates that patients who experienced no improvement in SCI had significantly higher NLR compared to those who showed improvement. On the other hand, a considerable heterogeneity was observed among studies, indicating potential variability in study populations, methodologies, timing of NLR measurement post injury, or their definition of no improvement because of their differences in injury severity classification.

Neutrophils are among the first immune cells to infiltrate the injured spinal cord, and their presence is closely related to the inflammatory response that follows SCI. Previous studies have indicated that neutrophils contribute to secondary injury through the release of pro-inflammatory cytokines and reactive oxygen species, which can exacerbate neuronal injury and delay the recovery cascade (22, 23). The damaging effects of neutrophils are further exacerbated by the occurrence of lymphocytopenia, which is observed after SCI and may reflect an impaired immune response that fails to neutralize the inflammatory effects of neutrophils (12).

From a clinical perspective, the NLR prognostic feature highlights the potential utility of NLR as a cost-effective and readily available biomarker for risk classification. Elevated NLR may indicate an elevated systemic inflammatory response, and early identification of patients at higher risk for poor outcomes could support targeted interventions in order to modulate the inflammatory response.

5. Limitations

During this study, there were some limitations. The number of studies that specifically investigated the NLR effect on the prognosis of SCI patients was small, which indicates the importance of further studies in this field. Moreover, all included studies were from China, which raises the risk of selection bias. Also, the significant heterogeneity observed in the effect size analysis warrants further investigation on the potential sources of variability, such as differences in NLR measurement timing, different populations, injury severity, or different treatment protocols among the studies. Heterogeneity in the meta-analysis may be partially explained by differences in how neurological improvement was defined and measured across studies. Although we standardized the inclusion criteria based on AIS grade conversion, variations

in timing and classification thresholds (e.g., AIS A to B vs. A to D) remain potential sources of inconsistency. Finally, since all included studies were observational and retrospective, the findings should be interpreted cautiously. Although NLR was consistently associated with poor outcomes, these results cannot confirm NLR as an independent prognostic factor. External validation through well-designed, prospective multicenter studies is essential to establish causal or prognostic independence.

Future studies should focus on well-designed, prospective multicenter trials that use standardized methods to confirm the prognostic significance of NLR in SCI. In particular, investigations should use specified NLR cut-off values that are based on the severity of the lesion to see how well they predict neurological outcomes. These kinds of efforts would assist in setting clinically useful benchmarks and make it easier to apply and reproduce results across a wide range of patient groups.

6. Conclusions

Elevated NLR is associated with greater injury severity and poorer neurological recovery in patients with acute traumatic spinal cord injury. While these findings suggest NLR may serve as a useful early prognostic biomarker, further prospective studies are needed to validate its independent predictive value before clinical implementation.

7. Declarations

7.1. Acknowledgments

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7.2. Author contributions

Conceptualization and study design: MY, HZ, SS

Screening and Data extraction: AP, HZ, MF, FT

Meta-analysis: HZ

Interpretation of the results: HZ, MY, AP, SS

Writing the manuscript: AP, HZ, MJ, AG, PG, MF, FT, PS, SS

Critical revision of the manuscript: All authors

All authors read and approved the final manuscript.

7.3. Ethics approval and consent to participate

Ethical approval was not required because all data were extracted from published studies.

7.4. Consent for publication

Not applicable.

7.5. Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

7.6. Competing interests

The authors declare that they have no competing interests.

7.7. Funding

This study was not funded or financially supported.

7.8. Using artificial intelligence chatbots

No artificial intelligence (AI)-assisted technologies were applied in the production of the submitted work.

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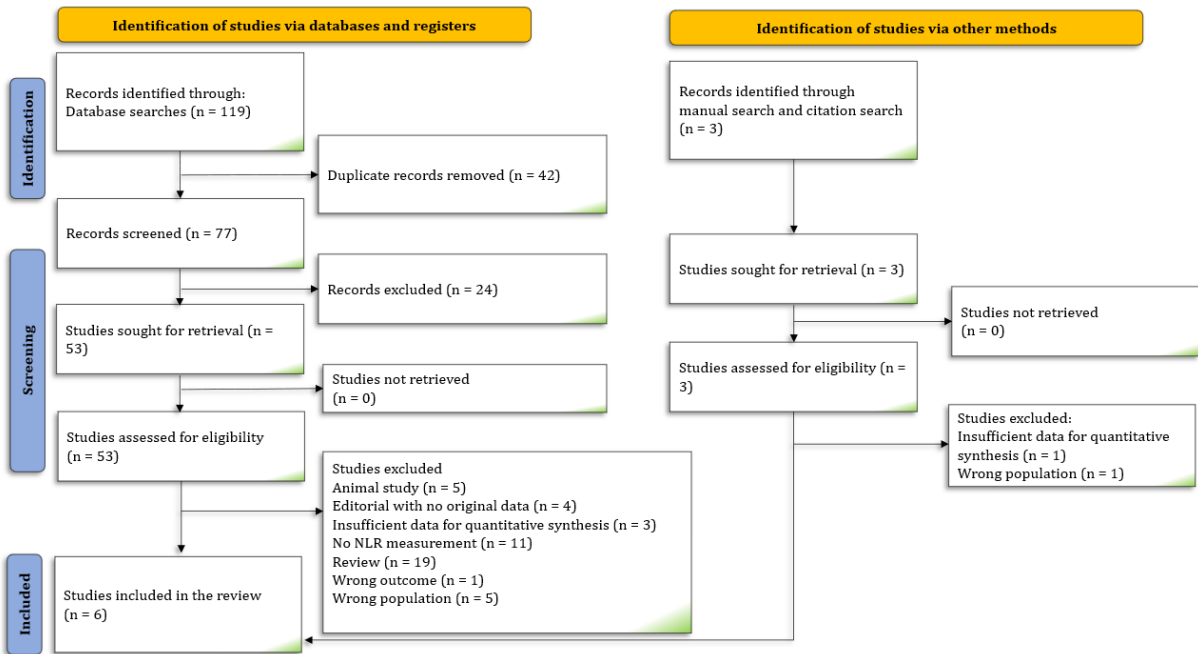


Figure 1: PRISMA (preferred reporting items for systematic reviews and meta-analyses) flow diagram of the screening process. NLR: Neutrophil-to-lymphocyte ratio.

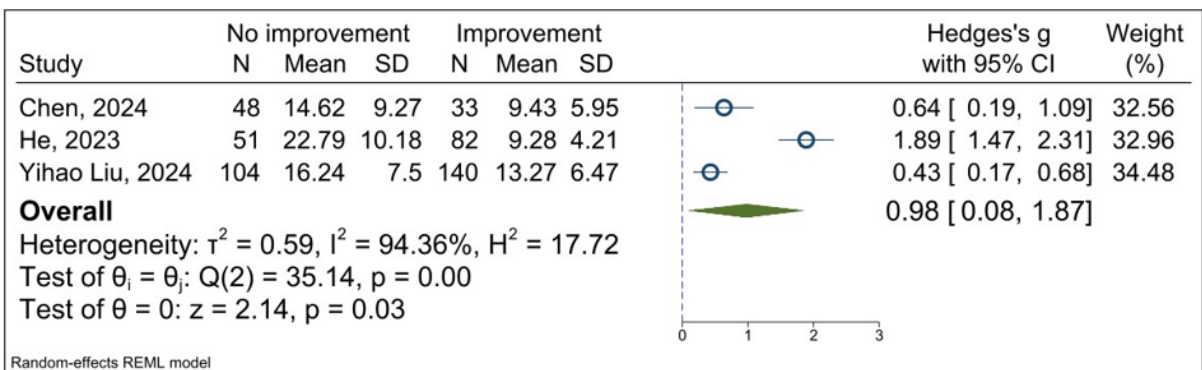


Figure 2: The forest plot for the prognostic value of neutrophil-to-lymphocyte ratio in predicting neurological improvement based on the American Spinal Injury Association (ASIA) level after traumatic spinal cord injury. SD: standard deviation; CI: confidence interval.

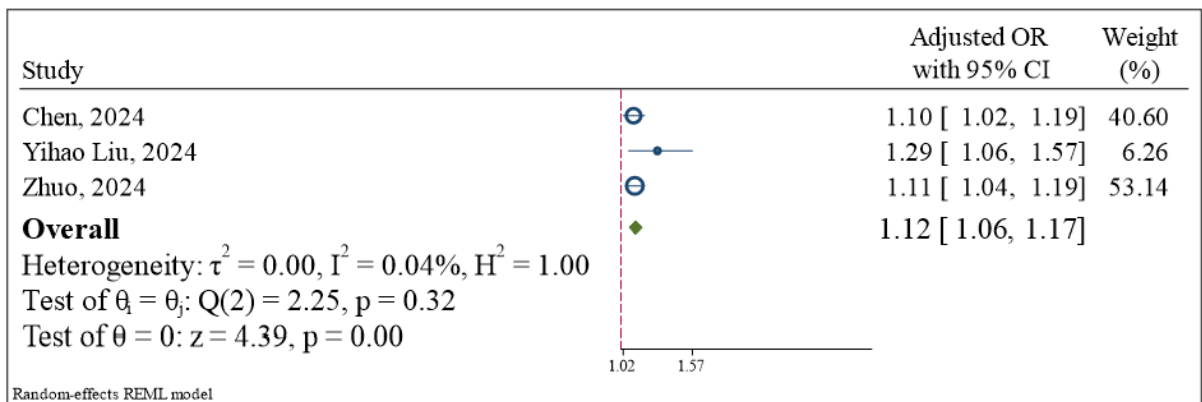


Figure 3: The forest plot for the prognostic value of neutrophil-to-lymphocyte ratio in predicting independent association with neurological improvement after traumatic spinal cord injury. CI: confidence interval; OR: odds ratio.

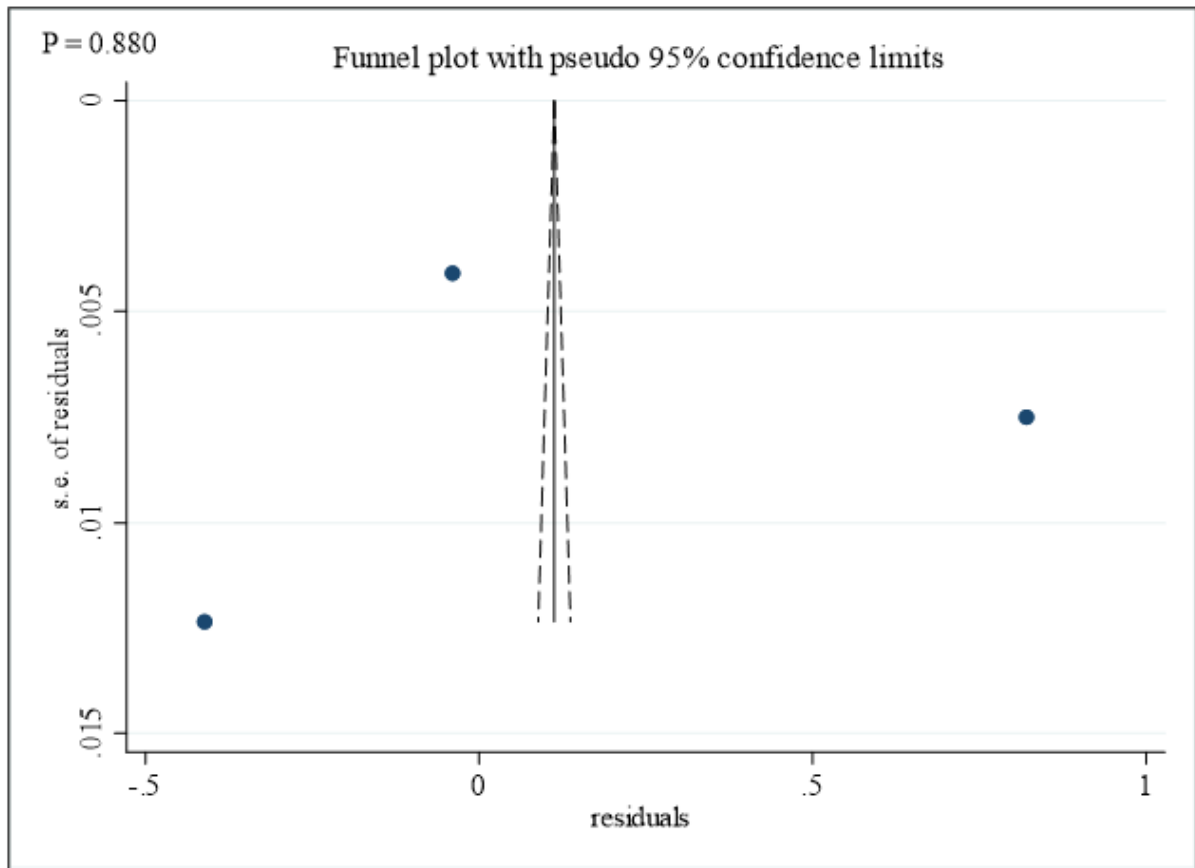


Figure 4: Publication bias among the included studies for evaluating neurological improvement following traumatic spinal cord injury. s.e: standard error.

Table 1: Summary of characteristics of the included studies

Author, Year, Country	Study Design, Study Type	Sample Size, Male Number	Age	Presentation to Sampling Interval (hrs)	Outcome Assessment Post-injury	Outcome Name	Outcome Definition
Chen, 2024, China (4)	Retrospective, Cohort	94 & 81, 78 & 66	53.62 ± 14.36 & 52.52 ± 13.10	6.13 ± 5.95 & 7.30 ± 7.30	After the spinal shock period & after 6 months	SCI severity & non-improvement	Complete SCI = AIS A (vs AIS B to D) & lower or equal ASIA nerve function grades (poor prognosis group) after operation than before operation
He, 2023, China (12)	Retrospective, Cohort	133, NM	NM	Within 72	After 6 months	Non-improvement	No improvement of ASIA grade (<72 hrs vs 6 months)
Liu, 2024, China (5)	Retrospective, Cohort	244, 220	54.90 ± 11.94	Within 24	After 12 months	Non-improvement	No improvement of ASIA grade (acute vs 1 year)
Zhao, 2020, China (15)	Retrospective, Cohort	377, 212	46.05 ± 17.93	Within 6	After 6 months	SCI severity	Complete SCI = AIS A to C (vs AIS D to E)
Zhou, 2023, China (6)	Retrospective, Cohort	526, 438	51.4 ± 12.6	Within 8	After the spinal shock period	SCI severity	Complete SCI = AIS A to B (vs AIS C to E)
Zhuo, 2024, China (10)	Retrospective, Cohort	190, 133	53 ± 13	Within 8	At discharge	SCI severity & non-improvement	AIS A-C (vs AIS D-E) at discharge & No improvement of ASIA grade (acute vs discharge)

NM: Not mentioned, SCI: Spinal Cord Injury, hrs: hours, ASIA: The American Spinal Injury Association, AIS: ASIA impairment scale

Table 2: Risk of bias assessment of the included studies based on the NHLBI's Quality Assessment Tool for Observational, Cohort and Cross-Sectional Studies

Study	Research question	Study population	Participation rate	Uniform eligibility criteria	Sample size justification	Exposure before outcome	Sufficient time-frame	Different exposure levels	Exposure measures	Repeated exposure assessment	Outcome measures	Outcome assessors' blinding	Follow-up rate	Statistical analyses	Overall
Chen, 2024	L	L	L	L	H	L	L	L	L	L	L	CD	L	L	L
He, 2023	L	L	L	L	H	L	L	L	L	L	L	CD	CD	L	L
Liu, 2024	L	L	L	L	H	L	L	L	L	L	L	CD	L	L	L
Zhao, 2020	L	L	L	L	H	L	L	L	L	L	L	CD	L	L	L
Zhou, 2023	L	L	CD	L	H	L	L	L	H	H	L	CD	NA	L	H
Zhuo, 2024	L	L	L	L	H	L	L	L	L	L	L	CD	L	L	L

L: Low risk, H: High risk, U: Unclear, CD: Cannot determine, NA: Not applicable

Table 3: Certainty of evidence regarding the association of higher Neutrophil-to-lymphocyte ratio (NLR) with neurological improvement

Outcome	Number of Studies	Risk of bias	Imprecision	Inconsistency (I2 range)	Indirectness	Publication bias	Level of evidence
Neurological Improvement	3	Not serious	No serious imprecision	Serious	Not serious	No publication bias	Moderate