Association between Systemic Immune-Inflammation Index and Systemic Inflammation Response Index and Outcomes of Acute Ischemic Stroke: A Systematic Review and Meta-Analysis

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Abstract

Systemic immune-inflammation index (SII) and systemic inflammation response index (SIRS) are being increasingly used to predict outcomes of various diseases. However, its utility for acute ischemic stroke (AIS) has not been established. Through this first systematic review and meta-analysis, we aimed to collate data on the prognostic ability of SII and SIRI for predicting functional outcomes and mortality after AIS. PubMed, CENTRAL, Scopus, Embase, and Web of Science were searched up to January 5, 2023, for studies reporting the association between SII or SIRI and outcomes of AIS. Adjusted data were pooled in a random-effects model. Meta-regression was conducted for variable cut-offs. Twelve studies were included. Pooled analysis of data showed that high SII was associated with poor functional outcomes after AIS (OR: 2.35 95% CI: 1.77, 3.10 $I^2 = 44\%$ $P < 0.00001$). Meta-regression showed an increasing effect size with a higher cut-off of SII. Similarly, the meta-analysis demonstrated that AIS patients with high SIRI were at an increased risk of poor functional outcomes (OR: 1.69 95% CI: 1.08, 2.65 $I^2 = 78\%$ $P = 0.02$). No association was noted with different cut-offs on meta-regression. Data on mortality were scarce but were suggestive of a higher risk of mortality with high SII and SIRI. SII and SIRI can be used to predict poor functional outcomes in AIS patients. Data on mortality are scarce to derive strong conclusions. Limited number of studies and variable cut-offs are important limitations that need to be overcome by future studies.

Keywords: Biomarker, blood cells, functional outcome, inflammation, mortality, stoke

Introduction

Stroke constitutes the second most common cause of mortality and disability across the globe with a larger burden shared by non-developed and developing countries.[1] As per the report of the American Heart Association, in 2016 there were 13.7 million new cases of incident stroke across the world and 87% of them were acute ischemic stroke (AIS).[2] Age continues to be a major risk factor, and while stroke incidence has declined in recent years; owing to the aging population, the lifetime risk of the disease has increased.[3] Management of AIS is directed at early reperfusion either by intravenous thrombolysis or endovascular thrombectomy or a combination of both.[4] Nevertheless, despite technological advances and improved treatment protocols, post-stroke mortality and disability continue to be a major problem[3], and there is a need for a simple, easy-to-use, and accurate prognostic indicator to improve the predictability of stroke outcomes.

Recent research has shown that post-stroke inflammation is an important factor that can exacerbate brain injury leading to worse outcomes.[5] Animal studies have shown that targeting the inflammatory response after stroke may subdue brain injury.[6] This suggests that post-stroke inflammation is an important prognostic factor, and indices correlating with systemic inflammation can be used for accurate prognostication and possible interventions in the future.[7] Indeed, there have been numerous studies on blood cell count-based inflammatory indices and outcomes of AIS.[8-10] Indices like neutrophil–lymphocyte ratio, platelet–lymphocyte ratio, and monocyte–lymphocyte ratio have all been used to predict prognosis in AIS but with varying results.[8,10] However, considering the complex pathophysiology of inflammation after AIS,[11] it is postulated that the usage of just two blood cell counts may restrict their prognostic ability, and hence, researchers have combined these ratios to generate the systemic immune-inflammation index (SII) and the systemic inflammation response index (SIRI). SII is calculated using platelet, neutrophil, and lymphocyte count, while SIRI is measured by neutrophil, monocyte, and lymphocyte count. These indices have been established as independent prognostic indicators in a variety of malignancies.[12-14] Furthermore, numerous studies have

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also examined their utility in AIS, but to date, no systematic review has been performed to collate evidence and present an overview of the results. Therefore, the purpose of this study was to conduct a thorough literature search and pool data on the prognostic ability of SII and SIRI for outcomes of AIS.

Material and Methods

Search and eligibility

The review protocol was deposited in the international prospective register of systematic reviews (PROSPERO) registry with the number CRD42023388149. It was ensured that the review was reported as per the guidelines of the PRISMA statement.[15]

The online search of PubMed, CENTRAL, Scopus, Embase, and Web of Science was completed on January 5, 2023, for studies relevant to the subject of the review. To encompass gray literature, a side search of Google Scholar was also done. Two reviewers conducted the entire process independently of each other and without any language restrictions. The search terms used were "systemic immune-inflammation index," "systemic inflammation response index," "stroke," and "cerebral infarction." Further details are shown in Supplementary Table 1.

Articles eligible for inclusion were all types of studies analyzing the relationship between SII or SIRS and outcomes of AIS patients. The inclusion criteria were further defined by PECO criteria as: population-AIS patients; exposure-high SII or SIRS; comparison-low SII or SIRS; outcomes-poor functional outcome or mortality. Outcomes were to be reported as adjusted effect sizes. The cut-off for SII or SIRS was not predefined, and all definitions of high SII/SIRS were acceptable. Poor functional outcome was also not predefined by the review.

Exclusion criteria were 1. studies not reporting any of the two outcomes or not reporting adjusted data, 2. studies not reporting separate data for AIS, and 3. studies with overlapping data (in such cases, the article with the highest sample was to be included).

Records from the search were pooled and deduplicated electronically. They were then scrutinized based on the eligibility criteria by two reviewers separately first at the title/abstract level and then at the full-text level. Articles fulfilling the inclusion criteria were finally selected. Any disagreements were solved by consensus. The references of included studies were also cross-checked for additional articles.

Data management and study quality

Data on the author's last name, publication year, study location, included population, sample size, age, male gender, hypertension and diabetes in the study population, the timing of measurement of SII, outcome assessed, cut-off used, method of obtaining cut-off, the definition of poor function outcome, and follow-up and effect ratios of outcomes were extracted by two reviewers independent of each other. Any conflicts were resolved by consensus. In case of missing data, the corresponding author was to be contacted once via email.

The studies were judged for risk of bias based on the Newcastle Ottawa Scale (NOS).[16] This scale awards "stars" or points for the selection of the study population, comparability of groups, and outcomes. Preformatted questions are available for each domain. The total score of a study can vary from 0 to 9.

Statistical analysis

Data on poor functional outcomes were combined as odds ratio (OR) with 95% confidence intervals (CI), while mortality data were pooled to generate hazard ratios (HR) with 95% CI. We chose to perform the analysis in a random-effects model owing to methodological variation among the studies. Inter-study heterogeneity was judged using the I^2 statistic. I^2 = 25–50% meant low, 50–75% meant medium, and more than 75% meant substantial heterogeneity. Funnel plots were used to detect publication bias. Outliners in the analysis were examined by "leave-one-out" analysis. "Review Manager" (RevMan, version 5.3; Nordic Cochrane Centre (Cochrane Collaboration), Copenhagen, Denmark; 2014) was the software selected for the meta-analysis. Meta-regression was conducted using meta-essentials in a random-effect model for poor functional outcomes. The covariates chosen were the cut-offs of SII and SIRI.

Results

The entire literature search showed up 176 unique articles and no additional articles from gray literature. One hundred and fifty-six studies were not relevant to the review. So the remaining 20 studies underwent full-text screening. Of these, a total of 12 articles fulfilled the inclusion criteria [Figure 1].[17-28] Six studies were on SII,[22,24-28] four on SIRI[17-19,21], and two[20,23] presented data for both indices. The interrater agreement for inclusion of studies was high ($\kappa = 0.9$).

SII

Details of SII studies are given in Table 1. The majority of studies on SII were from China with three studies from the USA, Korea, and Turkey. All studies were retrospective in nature. The sample size ranged from a minimum of 123 to a maximum of 9107 with a cumulative sample of 12,184 participants. The included patients were mostly elderly with a mean age of >60 years. Except for one,[24] all studies had predominantly male patients. More than half of the population was hypertensive with the percentage ranging from 51% to 74.7% across studies. However, the percentage of diabetics ranged from 13.3% to 33.5%. SII was measured at admission or before treatment across studies. There was variation in the SII cut-off across studies which was determined mostly by receiver operating characteristic (ROC) curve values from the individual study populations and ranged from 366 to 2140. All except for one study[27] reported data on functional outcomes. The definition of poor functional outcome was similar across studies, which was a modified ranking scale (mRS) score of ≥3. The follow-up point was similar at 90 days. The NOS score

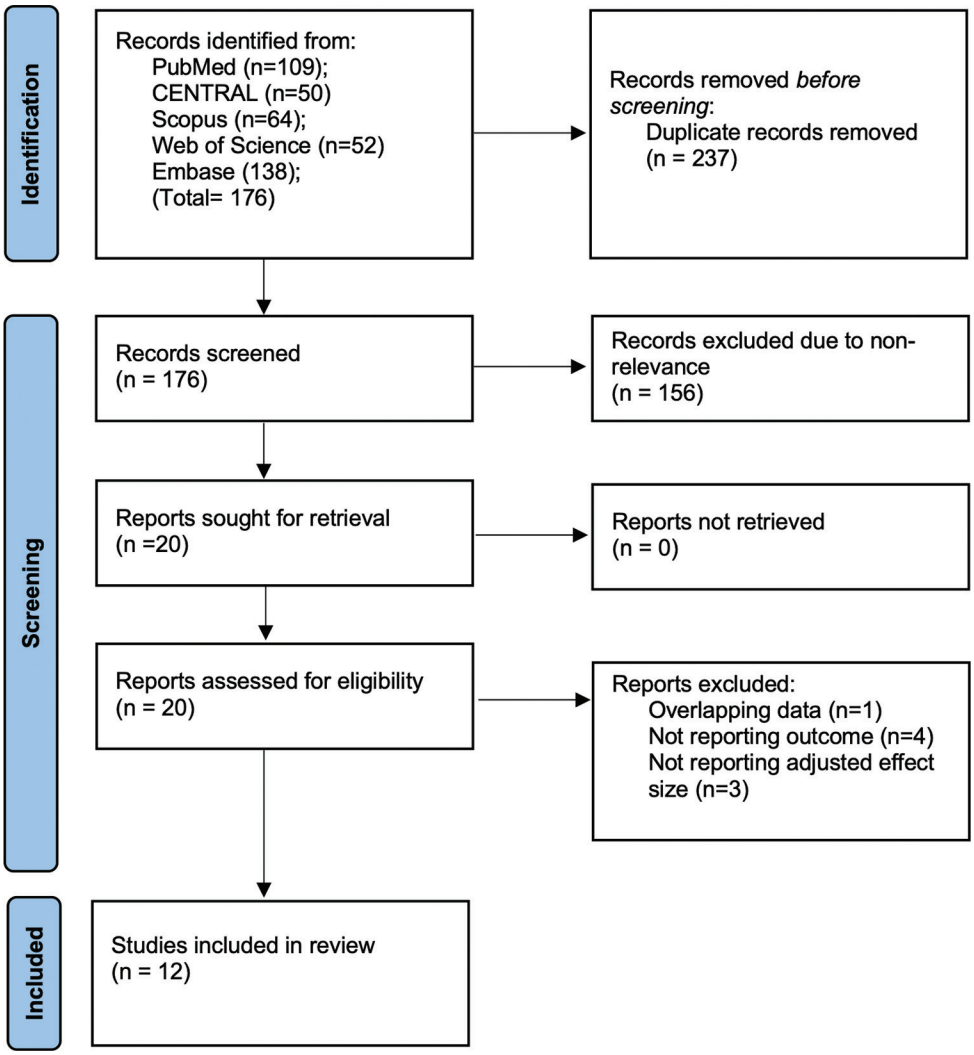

Figure 1: PRISMA flowchart

varied from 7 to 9. Further details of the score of each study are given in Table 2.

Pooled analysis of data showed that high SII was associated with poor functional outcomes after AIS (OR: 2.35 95% CI: 1.77, 3.10 $I^2 = 44\%$ $P < 0.00001$) [Figure 2]. The results failed to change during the leave-one-out analysis. There was no evidence of publication bias on funnel plot [Figure 3]. On meta-regression analysis, it was noted that the effect size increased significantly with a higher cut-off of SII [Figure 4]. The meta-regression values were Beta: 0.0009 95% CI: 0.0005, 0.0013 $P < 0.00001$. Data on mortality were available from just two studies. Meta-analysis showed a higher risk of mortality in patients with high SII (HR: 1.74 95% CI: 1.29, 2.35 $I^2 = 0\%$ $P < 0.0003$) [Supplementary Figure 1].

SIRI

Details of studies on SIRI are given in Table 3. Half of the studies were from China and the remaining from Italy, USA, and Korea. Except for Ma *et al*.,[17] all were retrospective studies. The total sample size was 3658 with individual sample sizes ranging from 63 to 2450. The study populations were predominantly elderly with a mean age of >60 years and had male predominance. When data were reported, more than half were hypertensives, and the number of diabetics ranged from 12.5 to 35.9%. The cut-off of SIRI ranged from 1.01 to 3.8 and was calculated by ROC analysis of individual cohorts. One study[19] reported data on mortality, while the remaining reported on poor functional outcomes. Like SII, all the studies used the same definition and follow-up duration for poor functional outcomes. The NOS score ranged from 7 to 8 [Table 4].

The meta-analysis demonstrated that AIS patients with high SIRI were at an increased risk of poor functional outcomes (OR: 1.69 95% CI: 1.08, 2.65 $I^2 = 78\%$ $P = 0.02$) [Supplementary Figure 2]. The results turned non-significant on the exclusion of Zhou *et al*.[21] (OR: 1.40 95% CI: 0.98, 1.99 $I^2 = 63\%$ $P = 0.07$) and Yi *et al*.[23] (OR: 1.56 95% CI: 0.96, 2.53 $I^2 = 75\%$ $P = 0.07$). There was no evidence of publication bias on funnel plot [Supplementary Figure 3]. On meta-regression, no association was noted between the effect size and different cut-offs of SIRI [Supplementary Figure 4]. The

Table 1: Details of studies on SII

Study	Location	Study design	Patient population	Sample size	Mean age	Male gender (%)	HT (%)	DM (%)	SII cut-off	Cut-off determination	Poor functional outcome	Follow-up
Zhou *et al*., 2022[28]	China	R	All AIS patients presenting in 24 h diagnosed with CT/MRI	208	63.3	68.8	60.1	16.3	802.8	ROC	mRS ≥3	90 days
Wu *et al*., 2022[27]	USA	R	AIS patients diagnosed based on ICD	1181	69.1	50.8	51	33.5	667.5	Baseline values	NR	90 days
Wang *et al*., 2022[26]	China	R	AIS patients presenting within 72 h	9107	61.9	69.7	62.8	23.3	366	NR	mRS ≥3	90 days & 1 year
Ji *et al*., 2022[25]	China	R	ICA or MCA AIS patients presenting within 24 h	675	67.1	59.6	65.9	16.6	2140	ROC	mRS ≥3	90 days
Huang 2022[20]	China	R	First ever AIS patients presenting within 24 h	234	69	50.4	70.1	22.6	1008.3	ROC	mRS ≥3	90 days
Acar *et al*., 2022[24]	Turkey	R	AIS patients undergoing endovascular therapy within 6 h	123	66.5	47.2	74.7	20.3	1690	ROC	mRS ≥3	90 days
Yi *et al*., 2021[23]	Korea	R	AIS caused by large artery occlusion undergoing mechanical thrombectomy	440	69.5	59	54	26.1	853	ROC	mRS ≥3	90 days
Weng *et al*., 2021[22]	China	R	AIS patients undergoing thrombolysis	216	68.5	63	61	21.3	545.14	ROC	mRS ≥3	90 days

AIS, acute ischemic stroke; R, retrospective; ICA, internal carotid artery; MCA, middle cerebral artery; mRS, modified ranking scale; NR, not reported; ICD, International Classification of Diseases; HT, hypertension; DM, diabetes mellitus; HT, hypertension; SII, systemic immune-inflammation index; CT, computed tomography; MRI, magnetic resonance imaging; ROC, receiver operating characteristics; NOS, Newcastle Ottawa scale

meta-regression values were- Beta: -0.0418 95% CI: -0.9185, 0.8349 $P = 0.87$. The singular study of Zhang *et al*.[19] showed that high SIRI was associated with increased risk of mortality in AIS at 90 days (OR: 1.36 95% CI: 1.16, 1.61) and 1 year (OR: 1.21 95% CI: 1.05, 1.38).

Discussion

Prognostication of AIS has been challenging, and researchers have explored a variety of biomarkers to accurately predict outcomes.[29] It cannot be understated that a precise marker of prognosis can significantly aid clinicians in identifying high-risk patients who can be prioritized and provided specialized care to obtain better outcomes. In this context, the results of the current systematic review assume clinical significance as it is the first in the literature to examine if SII and SIRI can be used to predict the prognosis of AIS patients. The first result analyzed in the meta-analysis was the functional outcome which is one of the most important measurements of recovery in any stroke patient. Importantly, all studies used the same mRS criteria and cut-off to determine functional recovery with a similar time point of 90 days. With this homogeneity, it was noted that both SII and SIRI were independent predictors of poor functional outcomes after AIS. High SII and SIRI were associated with 2.35 times and 1.69 times increased risk of poor functional outcome, respectively. Comparing the two, the sample size was larger with SII and the results were more robust as they did not lose statistical significance on sensitivity analysis. Furthermore, all studies on SII noted a significant result in their cohorts which was not the case for SIRI. For the second result of the meta-analysis, that is, mortality, data were scarce. Only two studies of SII and one study for SIRI were available. While these studies and our small pooled analysis demonstrated significantly higher mortality rates with elevated SII and SIRI, the results must be interpreted with caution owing to scarce data. These results need to be supplemented by future studies to increase the robustness of results.

The current results are supported by other published meta-analyses on SII and SIRI, which are mostly on cancer patients. Ji and Wang[12] in a review of nine studies have shown SII to be an independent predictor of poor survival, recurrence, and lymph node metastasis in gynecological and breast cancers. Similarly, Li *et al*.[30] and Zhang *et al*.[13] in their meta-analysis studies found that SII could predict survival and recurrence in urinary system cancers and gastrointestinal cancers, respectively. Parallelly, Zhang *et al*.[14] in a recent study including 11 studies with 19 cohorts showed that SIRI is associated with unfavorable outcomes in human cancers and pretreatment SIRI could be a useful prognostic indicator in such patients. Importantly, research on SII and SIRI has not been restricted only to cancers. Yang *et al*.[31] have found SII to be predictive of major adverse cardiovascular events in patients with coronary artery disease with SII outperforming conventional risk factors. Yun *et al*.[32] have shown both SII and SIRI can independently predict poor clinical outcomes

Table 2: Risk of bias analysis of SII studies by Newcastle Ottawa scale

Study	Selection of cohort	Comparability	Outcome assessment	Final score
Zhou *et al*., 2022[28]	****	**	*	7
Wu *et al*., 2022[27]	****	**	**	8
Wang *et al*., 2022[26]	****	**	***	9
Ji *et al*., 2022[25]	****	**	*	7
Huang 2022[20]	****	**	*	7
Acar *et al*., 2022[24]	****	**	**	8
Yi *et al*., 2021[23]	****	**	**	8
Weng *et al*., 2021[22]	****	**	*	7

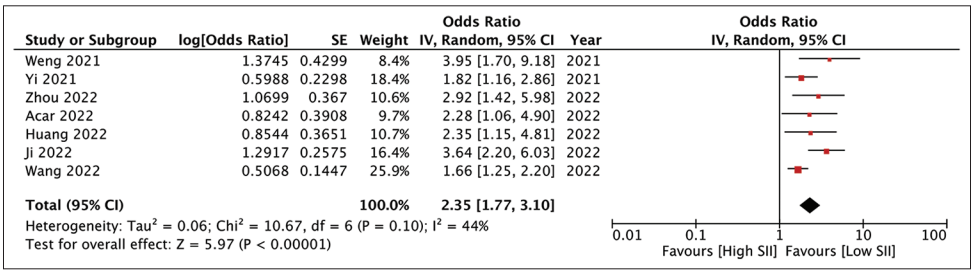

Figure 2: Meta-analysis of the association between high SII and 90-day poor functional outcomes after AIS

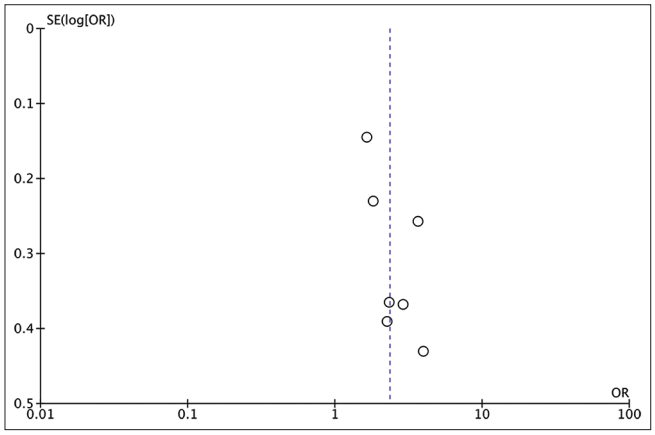

Figure 3: Funnel plot of the meta-analysis of the association between high SII and 90-day poor functional outcomes

in patients with aneurysmal subarachnoid hemorrhage. Mao *et al*.[33] have noted that SIRI can predict short-term and long-term mortality in traumatic brain injury patients and its predictive power was better than single indicators from peripheral blood counts.

Indeed, the very idea of creating SII and SIRI was to increase their predictive power by combining different peripheral blood cell markers. While SII is calculated by platelet count x neutrophil count/lymphocyte count, SIRI is measured purely by differential leucocyte counts as neutrophil count x monocyte count/lymphocyte count. Over the past decade, it has come forth that inflammation is closely related to the pathogenesis of AIS. It acts as a double-edged sword that can exacerbate brain injury and also aid in recovery in the long term.[11] However, peripheral blood cells have variable effects in this inflammation process and alteration in counts may lead to different outcomes. Neutrophils that peak at the ischemic site after 24 h secrete matrix metalloproteinase-9 and other inflammatory mediators, and higher concentrations associated with higher counts can damage the brain tissue and blood-brain barrier.[34] Damage to the barrier further increases the permeability of leucocytes, leading to additional complications like cerebral edema, bleeding, and worsening of neurological function.[35] Furthermore, higher neutrophil infiltration post-AIS has also been related to stroke severity.[34] Secondly, post-AIS stagnation of blood flow has been related to the expression of adhesion molecule P-selectin on blood cell surfaces. Platelets are known to form platelet–leucocyte aggregates using the P-selectin molecule which further exacerbates vessel occlusion leading to ischemic injury.[36] In contrast, the role of lymphocytes and monocytes in AIS has been controversial. Few studies show that lymphocytes act as neuroprotective agents by increasing interleukin (IL)-10 and reducing IL-6 and tumor necrosis factor-alpha,[37] while other research shows that specific types of lymphocytes like CD4+ and CD8+ T cells can generate cytotoxic and proinflammatory agents, namely IL-17 and interferon-gamma to further activate the inflammatory response and cause brain damage.[38] Similarly, monocytes have a multifaceted role in AIS, with peripheral monocytes entering the ischemic site and differentiating into macrophages with proinflammatory or anti-inflammatory phenotypes. While proinflammatory cells heighten the inflammation process and produce damage, protective macrophages limit the ischemic injury and promote cerebral modeling, angiogenesis, and resolution of inflammation.[39] Overall, the entire interaction of blood cells and the pathophysiology of AIS is complex warranting further research. However, considering the variable role of monocytes and lymphocytes in the pathophysiology, it may be postulated that SIRI (which includes monocyte

Table 3: Details of studies on SIRI

Study	Location	Study design	Patient population	Sample size	Mean age	Male gender (%)	HT (%)	DM (%)	SIRI cut-off	Cut-off determination	Poor functional outcome	Follow-up
Zhou *et al*., 2022[23]	China	R	First ever AIS presenting within 72 h	287	61.5	69	66.6	35.9	NR	NR	mRS ≥3	90 days
Ma *et al*., 2022[17]	China	P	First ever AIS treated with thrombolysis	63	65	69.8	NR	NR	1.01	ROC	mRS ≥3	90 days
Huang 2022[20]	China	R	First ever AIS patients presenting within 24 h	234	69	50.4	70.1	22.6	1.79	ROC	mRS ≥3	90 days
Zhang *et al*., 2021[19]	USA	R	AIS patients presenting within 48 h	2450	68	52	NR	NR	1.6	ROC	NR	90 days & 1 year
Yi *et al*., 2021[23]	Korea	R	AIS caused by large artery occlusion undergoing mechanical thrombectomy	440	69.5	59	54	26.1	2.9	ROC	mRS ≥3	90 days
Lattanzi *et al*., 2021[18]	Italy	R	AIS patients undergoing endovascular therapy	184	75	47.3	63.6	12.5	3.8	ROC	mRS ≥3	90 days

AIS, acute ischemic stroke; R, retrospective; P, prospective; mRS, modified ranking scale; NR, not reported; HT, hypertension; DM, diabetes mellitus; HT, hypertension; ROC, receiver operating characteristics; NOS, Newcastle Ottawa scale; SIRI, systemic inflammation response index

Figure 4: Meta-regression of different cut-offs of SII and poor functional outcomes

count) may be an inferior marker of prognosis as compared to SII (which includes platelet instead of monocyte count). This was somewhat noted in this review wherein the effect size of SIRI was smaller than SII and the results of the former not stable on sensitivity analysis.

One of the biggest drawbacks of the analysis is the variable cut-offs used by included studies. Such problems have been reported by other meta-analyses[12-14] as well as there is no standard cut-off for both SII and SIRI. To assess the influence of this variation, a meta-regression was performed which showed a higher prognostic ability of SII with higher cut-offs but no such relation in the case of SIRI. The lack of significant results for the latter could be due to a limited number of studies. At this point, a standard definition of both SII and SIRI cannot be suggested due to scarce literature and variability in study populations. However, it is recommended that clinicians should generate cut-offs in their respective healthcare setups to optimize the use of these indices in clinical practice.

Other limitations of the review include the predominance of retrospective observational data which is prone to bias. Several studies had small sample sizes, and the number of studies in SIRI was very less. Mortality data were scarcely reported by the studies which prohibited a comprehensive meta-analysis. While only adjusted data were included in the review, it is plausible that other known and unknown confounders could have influenced the outcomes, especially with variations in stroke severity and treatment modalities among studies. Lastly, most of the data were derived from Asian populations, and hence, the results need to be replicated in Western populations for a more generalized acceptance.

Conclusions

SII and SIRI can be used to predict poor functional outcomes in AIS patients. Data on mortality are scarce to derive strong conclusions. Limited number of studies and variable cut-offs are important limitations that need to be overcome by future studies.

Table 4: Risk of bias analysis of SIRI studies by Newcastle Ottawa scale

Study	Selection of cohort	Comparability	Outcome assessment	Final score
Zhou *et al*., 2022[21]	****	**	*	7
Ma *et al*., 2022[17]	****	**	*	7
Huang 2022[20]	****	**	*	7
Zhang *et al*., 2021[19]	****	**	**	8
Yi *et al*., 2021[23]	****	**	**	8
Lattanzi *et al*., 2021[18]	****	**	**	8

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Nil.

Conflicts of interest
There are no conflicts of interest.

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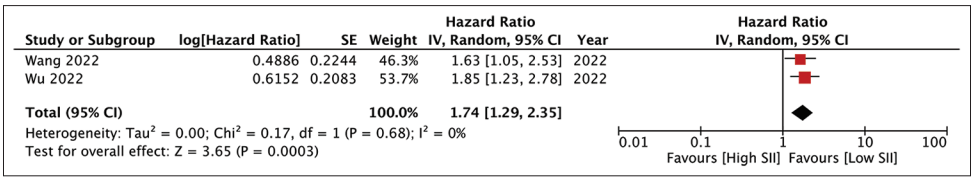
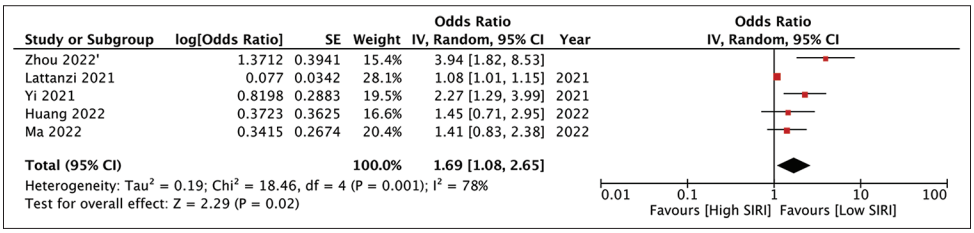
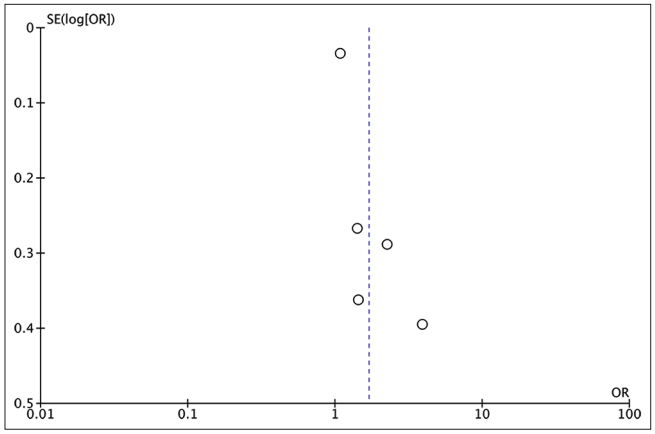


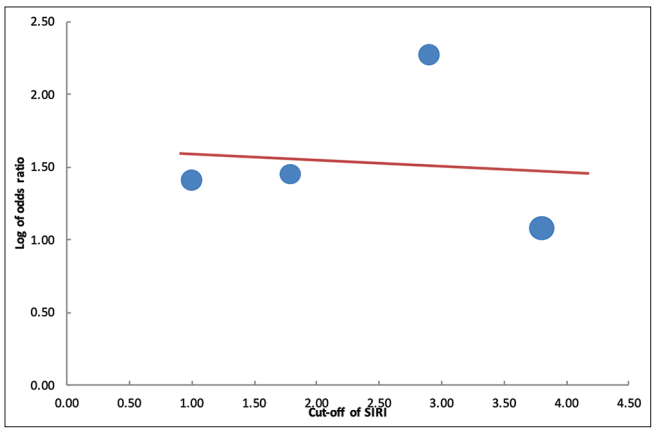
Supplementary Figure 1: Meta-analysis of the association between high SII and mortality after AIS



Supplementary Figure 2: Meta-analysis of the association between high SIRI and 90-day poor functional outcomes after AIS



Supplementary Figure 3: Funnel plot of the meta-analysis of the association between high SIRI and 90-day poor functional outcomes



Supplementary Figure 4: Meta-regression of different cut-offs of SIRI and poor functional outcomes

Supplementary Table 1: Search strategy

PUBMED

Query	Search details
((Systemic immune-inflammation index) OR (systemic inflammation response index)) AND (cerebral infarction)	((("systemic"[All Fields] OR "systemically"[All Fields] OR "systemics"[All Fields]) AND "immune-inflammation"[All Fields] AND ("abstracting and indexing"[MeSH Terms] OR ("abstracting"[All Fields] AND "indexing"[All Fields]) OR "abstracting and indexing"[All Fields] OR "index"[All Fields] OR "indexed"[All Fields] OR "indexes"[All Fields] OR "indexing"[All Fields] OR "indexation"[All Fields] OR "indexations"[All Fields] OR "indexe"[All Fields] OR "indexer"[All Fields] OR "indexers"[All Fields] OR "indexs"[All Fields])) OR (("systemic"[All Fields] OR "systemically"[All Fields] OR "systemics"[All Fields]) AND ("inflammation"[MeSH Terms] OR "inflammation"[All Fields] OR "inflammations"[All Fields] OR "inflammation s"[All Fields]) AND ("response"[All Fields] OR "responses"[All Fields] OR "responsive"[All Fields] OR "responsiveness"[All Fields] OR "responsivenesses"[All Fields] OR "responsives"[All Fields] OR "responsivities"[All Fields] OR "responsivity"[All Fields]) AND ("abstracting and indexing"[MeSH Terms] OR ("abstracting"[All Fields] AND "indexing"[All Fields]) OR "abstracting and indexing"[All Fields] OR "index"[All Fields] OR "indexed"[All Fields] OR "indexes"[All Fields] OR "indexing"[All Fields] OR "indexation"[All Fields] OR "indexations"[All Fields] OR "indexe"[All Fields] OR "indexer"[All Fields] OR "indexers"[All Fields] OR "indexs"[All Fields]))) AND ("cerebral infarction"[MeSH Terms] OR ("cerebral"[All Fields] AND "infarction"[All Fields]) OR "cerebral infarction"[All Fields])
((Systemic immune-inflammation index) OR (systemic inflammation response index)) AND (stroke)	((("systemic"[All Fields] OR "systemically"[All Fields] OR "systemics"[All Fields]) AND "immune-inflammation"[All Fields] AND ("abstracting and indexing"[MeSH Terms] OR ("abstracting"[All Fields] AND "indexing"[All Fields]) OR "abstracting and indexing"[All Fields] OR "index"[All Fields] OR "indexed"[All Fields] OR "indexes"[All Fields] OR "indexing"[All Fields] OR "indexation"[All Fields] OR "indexations"[All Fields] OR "indexe"[All Fields] OR "indexer"[All Fields] OR "indexers"[All Fields] OR "indexs"[All Fields])) OR (("systemic"[All Fields] OR "systemically"[All Fields] OR "systemics"[All Fields]) AND ("inflammation"[MeSH Terms] OR "inflammation"[All Fields] OR "inflammations"[All Fields] OR "inflammation s"[All Fields]) AND ("response"[All Fields] OR "responses"[All Fields] OR "responsive"[All Fields] OR "responsiveness"[All Fields] OR "responsivenesses"[All Fields] OR "responsives"[All Fields] OR "responsivities"[All Fields] OR "responsivity"[All Fields]) AND ("abstracting and indexing"[MeSH Terms] OR ("abstracting"[All Fields] AND "indexing"[All Fields]) OR "abstracting and indexing"[All Fields] OR "index"[All Fields] OR "indexed"[All Fields] OR "indexes"[All Fields] OR "indexing"[All Fields] OR "indexation"[All Fields] OR "indexations"[All Fields] OR "indexe"[All Fields] OR "indexer"[All Fields] OR "indexers"[All Fields] OR "indexs"[All Fields]))) AND ("stroke"[MeSH Terms] OR "stroke"[All Fields] OR "strokes"[All Fields] OR "stroke s"[All Fields])

EMBASE

#1. "systemic inflammation response index"
#2. "systemic immune-inflammation index"
#3. "stroke patient"
#4. #1 OR #2
#5. "cerebral infarction"
#6. #3 AND #4
#7. #4 AND #5

SCOPUS

1. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [stroke]
2. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [cerebral infarction]

CENTRAL

1. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [stroke]
2. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [cerebral infarction]

WEB OF SCIENCE

1. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [stroke]
2. ["Systemic immune-inflammation index" OR "systemic inflammation response index"] AND [cerebral infarction]