BALNEO RESEARCH Balneo and PRM Research Journal English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 8466 ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

What's Left When All Is Gone? Limitations of the ABCD2 score in Transient Ischemic Attacks

Anca Buliman [1], Marius P. Iordache [*1,2,3], Mirela Gabriela-Irina Protosevici [1,3], Mirela-Maria Coroescu [1], Ionica Oncioiu [2], Maria-Linda Popa [5] and Andrei-Cristian Bondar [1,4]

1. Faculty of Medicine, "Titu Maiorescu" University, 040441 Bucharest, Romania;
2. Doctoral School, "Titu Maiorescu" University, 040441 Bucharest, Romania;
3. Ilfov County Clinical Emergency Hospital, 022104 Bucharest, Romania;
4. Psychiatry Hospital "Prof. Dr. Alexandru Obregia", Soseaua Berceni 10, 041914 Bucharest, Romania;
5. Department of Cell Biology and Histology, "Carol Davila" University of Medicine and Pharmacy, 050474 Bucharest, Romania

* Correspondence: mariusiordache.neuro@gmail.com

Citation: Buliman A., Iordache M.P., Protosevici M.G.I., Coroescu M.M., Oncioiu I., Popa M.L., Bondar A.C. – What's Left When All Is Gone? Limitations of the ABCD2 score in Transient Ischemic Attacks
Balneo and PRM Research Journal ***2025****, 16(4): 919*

Academic Editor(s):
Constantin Munteanu

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Production Officer:
Camil Filimon

Received: 03.11.2025
Published: 30.12.2025

Reviewers:
Mihai Hoteteu
Alin Ciubotaru

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: The ABCD2 score is widely used for early stroke risk stratification following transient ischemic attack (TIA); however, a critical limitation is that low-risk scores may still fail to identify patients with treatable high-risk conditions, leading to missed opportunities for urgent intervention. This raises ongoing concerns about its predictive accuracy, applicability across diverse clinical settings, and the added value of incorporating neuroimaging or expanded clinical variables. A PRISMA-guided systematic review was performed, evaluating nine studies investigating the predictive performance and limitations of the ABCD2 score and its variants for early and late stroke risk, as well as their ability to distinguish TIA from mimics. Across 6,111 TIA patients and additional suspected-TIA cohorts, findings were heterogeneous. Several studies demonstrated only modest predictive accuracy, with the score performing best at identifying low-risk patients rather than reliably detecting those at highest risk. Importantly, multiple studies showed that patients with ABCD2 <4 still experienced clinically significant short-term stroke risk when underlying etiologies such as carotid stenosis or cardioembolism were present. Imaging-augmented variants (e.g., ABCD2-I, ABCD3-I) provided inconsistent or minimal incremental value. Moreover, up to 20% of suspected TIAs were mimics, and the ABCD2 score showed poor discriminatory ability in distinguishing them from true events. Although the ABCD2 score remains a practical initial tool for TIA triage, its limitations—including inconsistent predictive accuracy, inability to reliably identify all high-risk patients, and poor performance in differentiating mimics—underscore the need for comprehensive clinical assessment beyond simple scoring. Future large-scale prospective studies are required to validate augmented models and refine individualized risk-stratification strategies.

Keywords: transient ischemic attack, TIA, stroke, ABCD2 score, stroke risk

1. Introduction

Transient Ischemic Attacks (TIAs) are brief but critical neurological events that signal a substantially elevated risk of imminent ischemic stroke [1]. Defined by the World Health Organization as "a sudden, focal neurological deficit with symptoms lasting less than 24 hours and attributed to a cerebrovascular cause," TIAs occur due to transient interruption of blood flow to the brain, spinal cord, or retina, without resulting in acute infarction [2]. Although symptoms typically resolve within minutes to hours [3], the underlying mechanisms—most often atherosclerosis, cardioembolism, or small-vessel disease—are identical to those driving ischemic stroke and therefore place patients at markedly increased short-term and long-term risk [4]. Globally, TIA incidence ranges from 30 to 50 per 100,000 individuals annually, with a lifetime prevalence approaching 3% [1].

Without timely intervention, 10–20% of patients will experience a stroke within 90 days, and nearly half of these events occur within the first 48 hours, emphasizing the urgency of accurate early risk assessment [5,6].

In response to this clinical need, the ABCD2 score was developed as a rapid bedside tool incorporating age, blood pressure at presentation, clinical deficits, duration of symptoms, and diabetes status to estimate early stroke risk after TIA [7]. The score categorizes patients into low, moderate, and high-risk groups and has been widely incorporated into stroke-prevention pathways, including NICE recommendations in the UK, to prioritize urgent evaluation and management [8]. The ABCD2 score's simplicity and its ability to standardize TIA triage have led to broad adoption in emergency and outpatient settings. Its components, as shown in Table 1—age ≥60 years, elevated blood pressure, unilateral weakness, speech disturbance, symptom duration, and diabetes—are easily obtained, and its total score (0–7 points) provides an accessible means of estimating short-term stroke probability [9]. In clinical practice, the score assists in decisions regarding neuroimaging, secondary prevention therapies, and disposition planning, allowing high-risk individuals to be rapidly assessed while lower-risk patients may be safely managed in outpatient settings [1,4,10,11].

Table 1. Details of the ABCD2 Score (0–7 points)

Component	Criteria	Score
Age (years)	> 60	1
Blood Pressure (mmHg)	SBP > 140 or DBP > 90	1
Clinical Features	Unilateral weakness	2
	Speech disturbance without weakness	1
Duration of Symptoms (minutes)	≥ 60	2
	10–59	1
Diabetes	Present	1

Despite these advantages, growing evidence highlights important limitations and controversies that challenge the reliability of the ABCD2 score when used as a standalone triage instrument. Several independent validation studies have reported inconsistent predictive performance, with variability across populations, clinical settings, and stroke mechanisms [4,5]. Notably, elevated ABCD2 scores do not consistently identify patients with high-risk etiologies such as significant carotid stenosis or cardioembolic sources—conditions that may require urgent intervention despite a seemingly "low-risk" clinical profile [4,5]. Furthermore, although the score was designed to stratify stroke risk, it performs poorly in differentiating TIAs from mimics, which account for nearly half of referrals in some stroke-prevention services [8]. The proliferation of derived scores (e.g., ABCD2-I, ABCD3, ABCD3-I), incorporating brain imaging or carotid imaging, reflects attempts to overcome these shortcomings; however, most variants lack independent validation and have contributed to uncertainty regarding optimal risk-stratification strategies [4,5].

Additionally, conflicting guideline recommendations—such as the American Heart Association's threshold for admission (ABCD2 ≥3) versus UK guidance recommending specialist assessment within 24 hours for scores ≥4 and within one week for lower scores—highlight the ongoing debate surrounding the score's clinical utility and safety [4,5]. These discrepancies underscore the broader concern that the ABCD2 score may oversimplify the heterogeneous etiologies and risk trajectories observed in TIA populations.

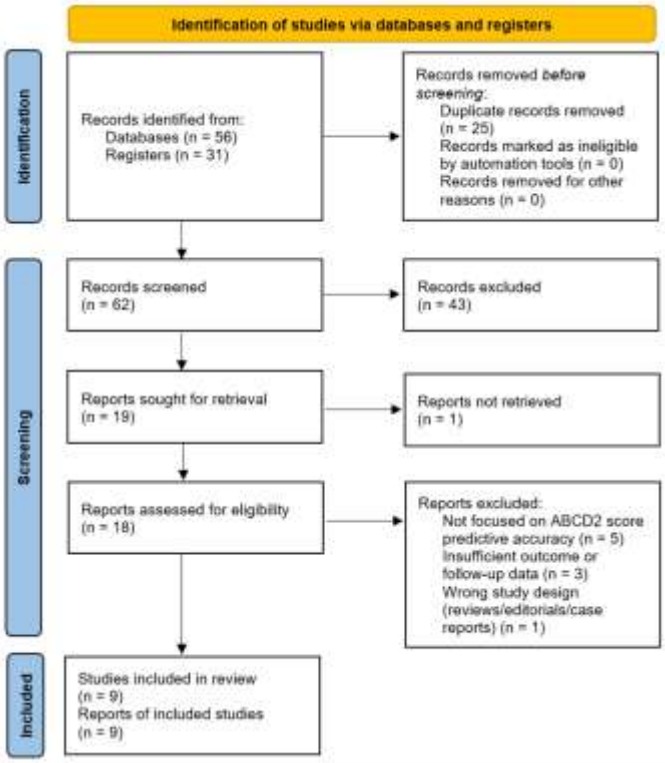
Given these unresolved issues, a focused examination of the limitations of the ABCD2 score is essential. This systematic review therefore synthesizes evidence from studies

evaluating its predictive accuracy, diagnostic shortcomings, dependence on patient population characteristics, lack of performance in distinguishing mimics, and the uncertain value of imaging-augmented variants. By clarifying where and why the ABCD2 score underperforms, this review aims to guide clinicians toward more nuanced, individualized, and evidence-aligned approaches for TIA risk stratification and stroke prevention.

2. Materials and Methods

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, presented in Figure 1, which ensured a methodologically transparent and reproducible approach [12]. The objective was to identify and synthesize existing evidence highlighting the diagnostic and prognostic limitations of the ABCD2 score in assessing stroke risk after Transient Ischemic Attacks (TIA).

Figure 1. PRISMA Diagram



Search Strategy. A thorough literature review was conducted using PubMed, Google Scholar, and Web of Science databases, including studies published between January 2010 and July 2025. The search strategy combined Medical Subject Headings (MeSH), as shown in Table 2, with free-text keywords, utilizing Boolean operators (AND/OR) to maximize both inclusivity and relevance.

Table 2. Keywords and MeSH Terms Used in the Literature Search

Category	Keywords and MeSH Terms
TIA/Stroke	"Transient Ischemic Attack" [MeSH] OR "TIA" OR "mini stroke"
Risk Score	"ABCD2" OR "ABCD2 Score" OR "ABCD Score"
Performance	"Predictive accuracy" OR "sensitivity" OR "specificity" OR "validation" OR "AUC"
Limitations	"Limitations" OR "misclassification" OR "underestimation" OR "diagnostic errors"
Outcomes	"Recurrent stroke" OR "90-day stroke" OR "ischemic stroke risk" OR "stroke progression"
Comparisons	"ABCD3" OR "ABCD3-I" OR "risk stratification tools" OR "clinical judgment"

Equivalent adapted search strings were applied to Google Scholar and Web of Science, using the same key terms. Additional articles were identified through cross-referencing relevant bibliographies.

Study Selection. Search results were imported into EndNote, where duplicates were removed. Two reviewers independently screened titles and abstracts. Full texts were subsequently evaluated against predefined inclusion and exclusion criteria.

Inclusion criteria:

- Focused on the predictive performance or limitations of the ABCD2 score in TIA patients,
- Reported sensitivity, specificity, or other performance metrics,
- Included adult populations,
- Were observational or cohort-based (prospective/retrospective) studies.

Exclusion criteria:

- Case reports, review articles, editorials, conference proceedings,
- Studies not using or not evaluating the ABCD2 score,
- Articles not in English,
- Non-human studies.

Disagreements were resolved through discussion or consultation with a third reviewer.

Data Extraction. A structured Excel extraction sheet was used to collect: study design, country, and setting; sample size and patient demographics, ABCD2 thresholds used; follow-up duration; outcomes (stroke recurrence at 2, 7, 30, and 90 days), whether imaging or modified scores (ABCD2-I, ABCD3-I) were evaluated; authors' descriptions of the score's limitations (e.g., poor mimic discrimination, underestimation in low-score patients, lack of imaging integration).

Risk of Bias and Quality Assessment. Because all included studies were observational (prospective or retrospective cohorts), methodological quality was assessed using the Newcastle–Ottawa Scale (NOS), which evaluates: selection of study groups; comparability of cohorts, outcome assessment, including follow-up adequacy.

The risk-of-bias evaluation informed interpretation of the heterogeneity and reliability of the findings but was not used to exclude studies. Details on limitations reported by authors, such as lack of imaging integration, underperformance in posterior circulation TIAs, and poor discrimination of recurrent risk in low- vs. high-risk populations, were noted.

Synthesis Approach. Given the heterogeneity of designs, settings, and outcome definitions, a narrative synthesis was chosen rather than a pooled meta-analysis. Key themes were organized around: predictive accuracy for early and late stroke, limitations in distinguishing TIAs from mimics, performance of ABCD2 in different populations and vascular territories, impact of imaging-augmented variants, frequency and clinical relevance of false-low scores.

3. Results

This systematic review included 9 studies encompassing a total of 6,111 patients with TIAs. Sample sizes across studies ranged from 176 to 1,679, including both anterior and posterior circulation TIA populations and patients with suspected TIA. Total patients accounted from all studies were 6,111 in number. Table 3 shows characteristics of studies included in this study.

Table 3. Characteristics of included studies

Reference	Country	Study Design	Sample size	Time from symptoms onset	Mode of ABCD score	Findings
Asimos et al., 2010 [9]	United States of America	Retrospective study	1,667 TIA patients	24 hours	Retrospective review of patient notes	The ABCD2 score showed only modest overall predictive ability for early ischemic stroke but was more effective in identifying patients at low risk for disabling stroke within 7 days, supporting its selective use for risk stratification rather than comprehensive clinical decision-making.
Chandratheva et al., 2010 [13]	United Kingdom	Prospective study	500 TIA patients	As soon as possible after TIA	In person	The ABCD2 score effectively predicted major recurrent stroke severity and associated healthcare costs, but was inversely related to recurrent TIA risk, highlighting its limitations in capturing the full spectrum of post-TIA outcomes and guiding admission decisions.
Purroy et al., 2010 [14]	Spain	Prospective study	310 TIA patients	48 hours	In person	The ABCD2 and ABCD2I scores were not effective predictors of stroke recurrence in this population, emphasizing that clinical scores and CT findings alone are insufficient to accurately assess post-TIA recurrence risk.
Holzer et al., 2010 [15]	Germany	Retrospective study	176 TIA patients	24 hours	Interviews, telephone	An ABCD2 score > 3 was associated with a higher risk of vascular events and death in medium- to long-term follow-up after TIA, suggesting its potential utility in broader cardiovascular risk stratification beyond short-term stroke prediction.
Ong et al., 2010 [16]	Singapore	Retrospective study	470 TIA patients		In person	The ABCD2 score showed good sensitivity and negative predictive value for predicting 7-day stroke risk, but its inability to ensure 100% safety means reliance on the score alone may still result in missed high-risk TIA cases discharged from the ED.
Sanders et al., 2011 [17]	Australia	Prospective study	512 consecutive patients with suspected TIA	Interviews and telephone	In person, telephone interviews	The ABCD2 score showed poor predictive value for stroke at both 2 and 90 days in confirmed TIA patients, indicating it should not be solely relied upon for clinical decisions or service planning in Australian tertiary care settings.
Amarenco et al., 2012 [18]	France	Prospective study	1679 SOS-TIA patients	24 hours	In person, telephone interviews	Despite lower ABCD2 scores, some patients had high short-term stroke risk due to treatable causes, underscoring the need for urgent evaluation of all TIA patients regardless of their ABCD2 score.
Cao et al., 2023 [19]	China	Prospective study	382 AC-TSI and 112 PC-TSI patients	7 days		The ABCD2 score demonstrated similar short-term predictive ability for recurrent stroke in both anterior and posterior circulation TSI at 90 days, highlighting its limited utility in differentiating stroke subtype risk.
Amort et al., 2011 [20]	Switzerland	Prospective cohort study	303 TIA patientss		In person	Nearly 1 in 5 patients with suspected TIA were ultimately diagnosed with TIA mimics, and while unilateral paresis favored true TIA, most clinical variables in risk scores like ABCD2 did not differentiate between mimics and actual TIA highlighting the score's limitations in diagnostic accuracy and emphasizing the better short-term prognosis of mimics.

AC, anterior circulation; PC, posterior circulation; SOS-TIA, Transient Ischemic Attack Outpatient Service with 24-hour access; TSI, transient symptoms with infarction.

The prospective SOS-TIA cohort study by Amarenco et al. (2012) [18] investigated the safety of delayed evaluation for TIA patients with an ABCD2 score <4, a strategy recommended by some national guidelines. Their examination of 1679 patients, primarily evaluated within a 24-hour window at a dedicated TIA clinic, revealed a 90-day stroke rate of 3.4% for those scoring ≥4 on the ABCD2 scale. Of particular note, patients with an ABCD2 score below 4 but who satisfied emergency treatment criteria (such as ≥50% internal carotid or intracranial artery stenosis, or a major cardiac source of embolism) had a 90-day stroke rate of 3.9%. This stands in stark opposition to patients with an ABCD2 score <4 who did not meet emergency treatment criteria, as their 90-day stroke rate was a notably lower 0.4% ($p<0.0001$ for the comparison across groups). This study concluded that, when feasible, TIA patients should undergo prompt evaluation irrespective of their ABCD2 score, as even those with lower scores may have treatable underlying causes associated with elevated short-term stroke risks [18].

Extending beyond short-term risk, Holzer et al. (2010) [15] explored the predictive value of the ABCD2 score for vascular outcomes during medium- to long-term follow-up in 176 TIA patients. At a median follow-up of 27 months, 22 patients (13.8%) experienced an ischemic stroke or TIA, 5 (3.0%) a myocardial infarction or acute coronary syndrome, and 10 (5.7%) died of vascular or unknown causes. The study found a significant association between an ABCD2 score >3 and a combined endpoint of cerebral or cardiovascular ischemic events and death of vascular or unknown cause (Hazard Ratio [HR] 4.01, 95% Confidence Interval [CI] 1.21–13.27). This association remained a strong trend even after adjusting for extracranial ultrasonographic findings as well as the heart failure (HR 3.13, 95% CI 0.94–10.49). Notably, new cardiovascular events occurred in 9 patients that had an ABCD2 score >3, but in no ne of the 53 patients that had a score ≤3. These findings suggest that an ABCD2 score >3 is linked with an increased risk for long-term vascular events following TIA [15].

Conversely, Asimos et al. (2011) [9] evaluated the accuracy of the ABCD2 score in predicting ischemic stroke within 7 days in a prospective, non-consecutive sample of 1667 admitted TIA patients. Their analysis revealed a modest discriminatory power for stroke within 7 days and a fair discriminatory power for disabling ischemic stroke within 7 days (c-statistic 0.71). Of particular note, patients categorized as low risk by an ABCD2 score (≤3) were found to be at low risk for having a disabling stroke within 7 days, along with a negative potential ratio of 0.16 (95% CI 0.04–0.64) with complete data and 0.34 (95% CI 0.15–0.76) with imputed missing values. This study suggests that the ABCD2 score's most effective application may be in identifying patients at low risk for early disabling ischemic stroke. They also highlighted the need for further research on the ability to determine an ABCD2 score in all patients and its validation in larger, consecutive TIA populations [9].

The utility of the ABCD2 score in emergency setting has been a subject of specific inquiry. Ong et al. (2010) [16] conducted a retrospective observational study to validate the ABCD2 score for stroke prediction after TIA in ED patients over a 2-year period. Among 470 patients diagnosed with TIA, they found that age ≥60 years and symptom duration ≥60 minutes were significant indicators of stroke at 2 days. An admission rule based on an ABCD2 score of ≥4 demonstrated a sensitivity of 86.4%/. Lowering the admission threshold to an ABCD2 score of ≥3 improved sensitivity to 96.6% and NPV to 96.1%, albeit increasing the admission rate from 69.1% to 83.6%. Despite the good sensitivity and NPV, the authors cautioned that the NPV was not 100%, implying that some patients discharged from the ED based on this cut-off could still return with a stroke, highlighting the persistent challenge of definitively ruling out future events [16].

4. Discussion

The diverse findings across studies regarding the ABCD2 score's utility underscore the complexities of stroke risk stratification after TIA. By reorganizing these findings around key thematic limitations, the challenges inherent in using the ABCD2 score as a standalone predictive tool become more clearly defined.

Inconsistent Predictive Accuracy Across Patient Populations. Significant variability exists in the ABCD2 score's ability to predict short-term and long-term stroke risk. Tsivgoulis et al. demonstrated strong discriminatory performance for 7-day (c-statistic 0.72) and 90-day stroke risk (c-statistic 0.75) across a multiethnic hospitalized cohort, supporting the clinical score's usefulness as an early risk-stratification tool [21]. In contrast, studies such as those by Sanders et al. showed poor predictive value at both 2 and 90 days among patients referred to Australian tertiary services [17], while Purroy et al. found that neither ABCD2 nor its imaging-augmented variants (ABCDI, ABCD2I) meaningfully predicted recurrent stroke in their cohort [14]. These discrepancies highlight substantial external-validation challenges and suggest that the ABCD2 score's performance is highly dependent on setting, case mix, and underlying etiology.

Yang et al. further demonstrated that an ABCD2 score >4 predicted long-term risk of stroke and death at an average follow-up of 40.5 months, adding support for its use as a general prognostic indicator [22]. However, taken together, the heterogeneous findings across studies reveal that while the ABCD2 score may perform well in some populations, its predictive accuracy is far from universal.

A further contributor to the inconsistent findings across studies is the substantial heterogeneity of study populations, which affects both the calibration and external validity of the ABCD2 score. Differences in ethnic composition, baseline vascular risk profiles, and prevalence of high-risk etiologies (such as intracranial atherosclerosis, more common in Asian cohorts) influence the distribution of ABCD2 components and may alter score performance. Likewise, variability in clinical pathways—including whether patients present through the emergency department, are evaluated in rapid-access TIA clinics, or are hospitalized—introduces differences in time to assessment, diagnostic workup, and outcome ascertainment. Access to vascular and brain imaging also differs markedly across health systems, affecting the detection of treatable high-risk conditions and the classification of recurrent events. These variations collectively contribute to the heterogeneous predictive accuracy reported in the literature and underscore that ABCD2 performance cannot be assumed to generalize across populations or healthcare settings.

Limited Value of Imaging-Augmented Variants. Modified versions such as ABCDI, ABCD2I, ABCD3, and ABCD3-I were designed to enhance prediction by incorporating neuroimaging or carotid imaging. Yet Purroy et al. found that adding CT findings did not improve predictive performance in their REGITELL cohort [14]. This contrasts with earlier assumptions that more comprehensive clinical-imaging models would naturally enhance prognostic accuracy. The lack of consistent benefit across studies indicates that simply adding imaging variables does not necessarily yield a more robust score, and that etiologic factors may be more influential than early CT findings in determining recurrence risk.

Failure to Reliably Detect High-Risk Etiologies in Low-Scoring Patients. One of the most clinically important limitations is the ABCD2 score's inability to reliably identify dangerous underlying causes—particularly carotid stenosis or cardioembolic sources—in patients with low clinical scores. The SOS-TIA study by Amarenco et al. demonstrated that patients with ABCD2 <4 who nevertheless met criteria for emergency treatment (e.g., ≥50% carotid stenosis or a major cardiac embolic source) had a 90-day stroke risk (3.9%) comparable to patients scoring ≥4 (3.4%) [18]. This finding directly challenges guideline practices that permit delayed evaluation of low-scoring patients and reinforces the need for etiologic assessment in all TIA presentations. Asimos et al. similarly showed that while low ABCD2 scores identified individuals at low risk for disabling stroke within 7 days, the score had only modest discriminatory power overall, underscoring that low-scoring patients are not universally low-risk [9]. Ong et al. demonstrated good sensitivity and negative predictive value when using a threshold of ≥3 in emergency settings but emphasized that the NPV was not 100%, meaning some patients discharged based on low scores still suffered early strokes [16]. These findings collectively stress that low ABCD2 scores do not guarantee safety.

Poor Differentiation Between True TIAs and Mimics. Amort et al. highlighted that nearly 20% of suspected TIA cases are ultimately diagnosed as mimics and that the ABCD2 score offers limited ability to distinguish between them [20]. Although unilateral weakness is more predictive of true vascular events, most clinical features included in ABCD2 do not meaningfully differentiate mimics from TIAs. This limitation is particularly important in high-volume TIA clinics, where reliance on ABCD2 could lead to misclassification, inappropriate reassurance, or unnecessary admissions.

Performance Across Vascular Territories. Whether the ABCD2 score performs differently in anterior versus posterior circulation TIAs remains an area of uncertainty. Cao et al. found that the score demonstrated equivalent predictive ability for recurrent stroke at 7 and 90 days in both anterior (AC-TSI) and posterior circulation TSI (PC-TSI) cohorts [19]. This contrasts with earlier assumptions that posterior circulation TIAs inherently weaken the score's accuracy. The consistency observed by Cao et al. suggests that vascular territory itself may not significantly alter performance—rather, the score's inherent clinical simplicity limits its predictive accuracy across all TIA subgroups.

Imaging and Recurrence Patterns as Stronger Predictors Than ABCD2 Alone. Purroy et al. emphasized that recurrent TIA episodes and atheromatous etiology were stronger predictors of early and 90-day stroke risk than ABCD2 or its imaging-augmented variants [14]. This reinforces the hypothesis that etiologic mechanisms—rather than symptom-based scoring—drive short-term recurrence risk. This finding is consistent with broader literature emphasizing that modern TIA evaluation must prioritize mechanism rather than clinical phenomenology alone.

When synthesized across studies, the evidence demonstrates that although the ABCD2 score can be useful for rapid initial assessment and occasionally for identifying low-risk individuals, its limitations span predictive accuracy, etiologic detection, diagnostic differentiation, and population generalizability. Even studies supporting ABCD2 utility, such as those by Tsivgoulis [21] and Yang [22], do so within specific contexts that are not universally replicable across real-world care pathways. Overall, the literature supports a shift away from reliance on the ABCD2 score in isolation and toward comprehensive, mechanism-based evaluation that incorporates vascular imaging, cardiac workup, and recurrence history [23-27].

Limitation

Our study, like others in this field, faces several limitations. The retrospective nature of some included studies might introduce selection bias and information bias, as data collection wasn't standardized. Variability in diagnostic criteria for TIA and follow-up protocols across studies could also impact the generalizability of findings. Furthermore, the heterogeneity of patient populations (e.g., hospitalized vs. ED presentations, different ethnic groups) and the evolution of stroke prevention strategies over time may influence reported outcomes. The reliance on the ABCD2 score, while widely used, has inherent limitations, as evidenced by conflicting validation results and its inability to fully capture the complexity of TIA etiology and individual patient risk.

Additionally, several methodological constraints should be acknowledged. First, the review may be subject to publication bias, as studies reporting significant or favorable validation outcomes of the ABCD2 score are more likely to be published than negative or neutral findings. Second, due to substantial heterogeneity in study designs, outcome definitions, imaging practices, and follow-up intervals, we did not perform a meta-analysis, limiting our ability to generate pooled effect estimates or quantitatively assess between-study variability. Third, the included studies relied on non-standardized diagnostic criteria for TIA, with differences in whether diagnoses were based on time-based definitions, tissue-based definitions using MRI, or clinician judgment. Such variability affects both the comparability of cohorts and the interpretation of prognostic accuracy.

These methodological inconsistencies highlight the need for future research using harmonized diagnostic definitions, standardized reporting of outcomes, and prospective designs to minimize bias and enhance reproducibility.

5. Conclusions

The ABCD2 score has long served as a practical and widely adopted bedside tool for the initial triage of patients with suspected TIA; however, the evidence synthesized in this review demonstrates that its predictive utility is inconsistent and insufficient when used as a standalone determinant of urgency or management. Across diverse populations and healthcare settings, the score exhibits variable discriminatory accuracy, limited ability to detect high-risk etiologies in low-scoring patients, and poor performance in distinguishing true TIAs from mimics. Imaging-augmented variants offer only modest and inconsistent improvements, further underscoring the limitations of symptom-based risk stratification in an era of rapid diagnostic advances.

Given these shortcomings, reliance on the ABCD2 score alone risks delaying the detection and treatment of clinically significant, potentially preventable stroke mechanisms. Contemporary TIA management therefore requires a broader, mechanism-centered approach that integrates vascular imaging, cardiac evaluation, and individualized clinical judgment for all patients, regardless of ABCD2 classification. This shift not only aligns with growing evidence but also better reflects the heterogeneity of TIA presentations and the availability of modern diagnostic pathways.

Future research should prioritize the development of multimodal risk-stratification tools that incorporate clinical data, vascular and neuroimaging findings, and emerging biomarkers of vascular instability, inflammation, and cardiac embolism. Such models may offer superior predictive performance by capturing the underlying pathophysiologic processes rather than relying on symptom duration and phenotype alone. In addition, evolving population demographics and improvements in acute TIA evaluation necessitate recalibration of existing thresholds and updated weighting of score components to better reflect contemporary patient profiles. Large-scale, prospective, multicenter studies using standardized diagnostic definitions and uniform outcome measures are essential to enable rigorous external validation, reduce methodological inconsistencies, and minimize biases present in prior research. Finally, machine-learning and data-driven analytic approaches hold substantial promise for identifying novel predictors, optimizing risk thresholds, and uncovering nonlinear interactions that traditional scoring systems cannot capture.

In summary, the ABCD2 score should be regarded as a supplementary clinical aid rather than a gatekeeper for triage or urgency determination. A comprehensive, individualized, and mechanism-informed strategy is essential to ensure patient safety and improve early stroke prevention. Continued innovation in risk modeling—supported by harmonized diagnostic standards and advanced analytic methods—will be critical to establishing a next-generation framework capable of delivering accurate, equitable, and clinically actionable TIA risk prediction.

Author Contributions: Conceptualization, A.B., M.P.I., C.M.M. A.C.B.; methodology, A.B., M.P.I., M.G.I.P.; software, M.P.I., M.G.I.P., C.M.M., I.O..; validation, M.G.I.P., I.O., M.L.P.; formal analysis, A.C.B., I.O, M.L.P.; investigation, M.P.I, A.B., A.C.B.; resources, A.B, M.P.I., A.C.B., M.G.I.P., C.M.M., I.O., M.L.P.; data curation, A.B., M.P.I., I.O.,; writing—original draft preparation, A.B., M.P.I., A.C.B; writing—review and editing, M.G.I.P., C.M.M., I.O., M.L.P; visualization, A.B., M.G.I.P., C.M.M., I.O., M.L.P.; supervision, M.G.P.I., I.O., M.L.P.; project administration, I.O., M.L.P.; funding acquisition, A.B, M.P.I., A.C.B., M.G.I.P., C.M.M., I.O., M.L.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest

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