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Study The Utility Of The Thrive Score In Cases Of Acute Ischemic Stroke

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Abstract:
Background*: The THRIVE (Totaled Health Risks in Vascular Events) score integrates key clinical parameters to predict outcomes in acute ischemic stroke (AIS) patients. Acute ischemic stroke, a condition characterized by the sudden interruption of blood flow to the brain, demands swift and accurate evaluation to initiate timely interventions and improve patient outcomes.[2] The Thrive Score, a relatively recent addition to the diagnostic arsenal which offers a comprehensive approach by amalgamating various clinical parameters.[3] These parameters include patient age, NIHSS, and comorbidities like Diabetes Mellitus, Hypertension and Atrial Fibrillation, creating a new scoring system that aims to provide a holistic representation of stroke severity.[4]*
Materials and Methods: *A prospective cohort study was conducted at MGM Medical College, Navi Mumbai, from August 2023 to December 2024. The study included 66 patients who reported to the Emergency Department of MGM Hospital with signs and symptoms indicative of acute ischemic stroke. Patients with AIS were included based on clinical and radiological criteria. THRIVE scores were calculated at admission. Outcomes at 90 days were assessed using the Modified Rankin Scale (mRS). Hemorrhagic transformation was documented post-thrombolysis. Statistical analysis included logistic regression and ROC curve comparisons.*
Results*: The THRIVE score significantly predicted 90-day mortality, poor functional outcome (mRS ≥3), and hemorrhagic transformation. ROC analysis demonstrated fair predictive value when compared to NIHSS.*
Conclusion: *The THRIVE score is a simple, bedside tool offering reliable prognostic value in AIS, aiding in early clinical decision-making.*
Key Word: *Acute Ischemic Stroke, THRIVE Score, Prognosis, Functional Outcome, Hemorrhagic Transformation*

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I. Introduction

Acute ischemic stroke (AIS) remains a major cause of morbidity and mortality globally. Effective early prognostication can guide treatment decisions and resource allocation. Acute ischemic stroke, a medical emergency characterized by the sudden loss of blood supply to a part of the brain, stands as a formidable challenge in healthcare.[2] It represents a critical manifestation of cerebrovascular disease, demanding swift and targeted interventions to mitigate its potentially devastating consequences.[5] Typically arising from a thrombotic or embolic occlusion of cerebral arteries, acute ischemic stroke can result in a cascade of neurological deficits ranging from mild impairment to profound disability or even death. The urgency in managing acute ischemic stroke stems from the irrevocable nature of neuronal damage, emphasizing the need for prompt medical attention. The THRIVE (Totaled Health Risks in Vascular Event) Score, a relatively recent addition to the diagnostic arsenal offers a comprehensive approach by amalgamating various clinical parameters which include patient age, NIHSS, and comorbidities like Diabetes Mellitus, Hypertension and Atrial Fibrillation. This study evaluates its utility in AIS management. It is a scoring system which aims to provide a holistic representation of stroke severity.[4]

II. Material And Methods

A prospective cohort study was conducted at MGM Medical College, Navi Mumbai, from August 2023 to December 2024. A total of 66 patients who reported to the Emergency Department of MGM Hospital with signs and symptoms indicative of acute ischemic stroke were included in this study. Patients with AIS were

included based on clinical and radiological criteria. THRIVE scores were calculated at admission. Outcomes at 90 days were assessed using the Modified Rankin Scale (mRS). Hemorrhagic transformation was documented post-thrombolysis. Statistical analysis included logistic regression and ROC curve comparisons.

Study Design: Prospective cohort study

Study Location: This was a hospital-based study conducted at MGM Medical College, Navi Mumbai.

Study Duration: August 2023 to December 2024

Sample size: 66 patients.

Sample size calculation: The sample size was estimated on the basis of the formula $n = \frac{Z^2PQ}{L^2}$. We assumed that the confidence interval 95%. The calculated sample size was 59, and approximately 10% of the calculated sample size was added to account for potential dropouts, resulting in a total sample size of 66.

Subjects & selection method: The study population was drawn from patients who presented to MGM Medical College, Navi Mumbai with signs and symptoms indicative of acute ischemic stroke between August 2023 to December 2024.

Inclusion criteria:
1. Patients presenting with signs and symptoms of cerebrovascular accident (CVA)
2. Age between 18 to 80 years
3. Both sexes
4. Patients who agreed to give written informed consent to participate in the study

Exclusion criteria:
1. Age less than 18 years or more than 80 years
2. Patients with hemorrhagic cerebrovascular accident
3. Patients presenting with stroke mimics
4. Patients not willing to give consent to participate in the study

Procedure methodology

Data were collected using a predesigned, prevalidated standard research tool to ensure consistency and accuracy across all participants. The data collection process was comprehensive and included categories as demographic information-Age, sex, OP/IP number, address, phone number, date of admission, socio-economic status (self-reported by the patient or family members), education (self-reported by the patient or family members). A thorough clinical history was recorded to capture the participants' medical background and any pre-existing conditions that could influence stroke outcomes which included chief complaints, history of present illness, A detailed account of the current illness episode, including the onset, duration, and progression of symptoms. Documentation of any history of high blood pressure, a significant risk factor for stroke. Self-reported by the patient or family members. Recording of diabetes history, which can impact stroke prognosis. Self-reported by the patient or family members. Presence of atrial fibrillation, a common comorbidity that increases the risk of stroke. Self-reported by the patient or family members. Presence of other risk factors if present which are found to be associated with stroke were also recorded. Self-reported by the patient or family members.

The general examination provided vital signs and basic health indicators upon admission, offering an immediate snapshot of the patient's condition. This included temperature to check for any signs of infection or other abnormalities, pulse to assess heart rate and rhythm, blood pressure-To determine the severity of hypertension and respiratory rate to evaluate breathing status, SpO2 to record oxygen saturation levels, indicating respiratory efficiency and random blood sugar assessment.

A thorough systemic examination was conducted to identify any abnormalities in major body systems that could affect stroke outcomes. This included:

Central Nervous System (CNS): Detailed neurological examination to assess higher mental functions, cranial nerve examination, motor and sensory functions, reflexes, and cerebellar functions.

Cardiovascular System (CVS): Examination of heart sounds, and potential murmurs or additional heart sounds.

Respiratory System (RS): Assessment of lung sounds, respiratory effort, and any signs of respiratory distress.

Per Abdomen (P/A): Examination of the abdomen for any signs of organomegaly, tenderness, or other abnormalities.

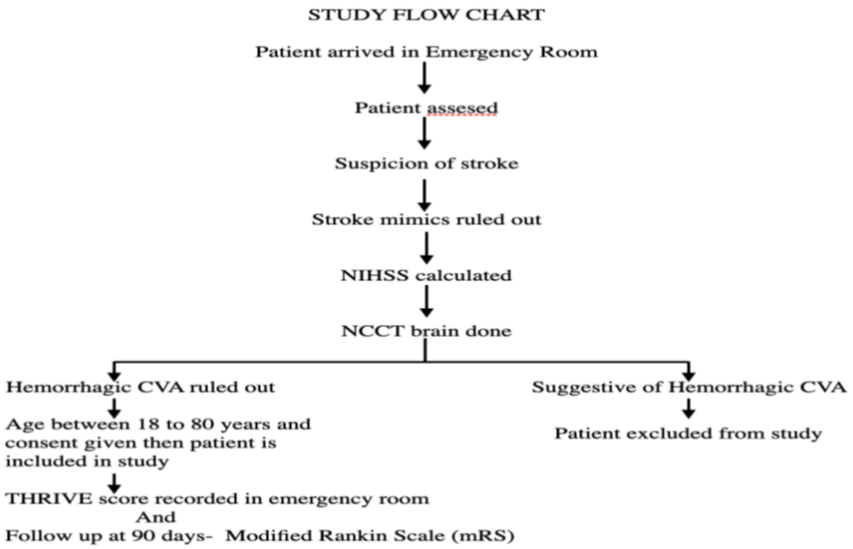
Standardized scoring systems were used to quantify stroke severity and predict outcomes, recorded at two critical points:

NIHSS Score: The National Institutes of Health Stroke Scale (NIHSS) score was calculated in the emergency room to assess the initial severity of the stroke. This scale evaluates multiple aspects of brain function, including consciousness, vision, sensation, movement, speech, and language.

THRIVE Score: The THRIVE (Totalled Health Risks in Vascular Events) score was also recorded in the emergency room. This score combines the NIHSS score, age, and history of hypertension, diabetes mellitus, and atrial fibrillation to predict long-term functional outcomes and mortality risk.

Modified Rankin Scale (mRS): The mRS was used to assess the degree of disability or dependence in daily activities at the 90-day follow-up. This scale ranges from 0 (no symptoms) to 6 (death), providing a comprehensive measure of recovery and long-term outcome.

Study Flow



THRIVE SCORE

Age: ≤ 59 years: 0 points
60 - 79 years: 1 point
≥ 80 years: 2 points
National Institutes of Health Stroke Scale (NIHSS) Score:
≤ 10: 0 points
11 - 20: 2 points
≥ 21: 4 points
Medical Comorbidities:
Hypertension: 1 point
Diabetes Mellitus: 1 point
Atrial Fibrillation: 1 point

Scoring and Interpretation
The THRIVE score ranges from 0 to 9 points.

Lower THRIVE Scores are better, indicating a higher chance of good neurological outcomes and lower mortality risk.
Higher THRIVE Scores indicate a higher risk of poor outcomes and increased mortality.

Predictive Values of the THRIVE Score
THRIVE Score of 0: Predicts a 79-88% chance of a good neurological outcome.
Predicts a 0-2% mortality rate at 90 days.

THRIVE Score of 9: Predicts a 7-16% chance of a good neurological outcome.

Predicts a 38-58% mortality rate at 90 days.

The THRIVE score is valuable because it incorporates factors that are easily obtainable and not influenced by treatment decisions, making it a reliable predictor of long-term outcomes. It helps clinicians assess the prognosis of patients with acute ischemic stroke and make informed decisions regarding their care.

III. National Institutes Of Health Stroke Scale (NIHSS)

The NIHSS is a standardized tool used to quantify the severity of a stroke. It assesses various aspects of brain function, including consciousness, vision, sensation, movement, speech, and language. Each function is assigned a score, and the total NIHSS score ranges from 0 to 42, with higher scores indicating more severe neurological impairment.

NIHSS Score Components

1.Level of Consciousness: Questions (e.g., patient's age and month): 0-2 points Commands (e.g., open/close eyes, grip/release hand): 0-2 points 2. **Best Gaze**: 0-2 points 3. **Visual Fields**: 0-3 points 4. **Facial Palsy**: 0-3 points 5. Motor Arm: Left arm: 0-4 points, Right arm: 0-4 points 6. Motor Leg: Left leg: 0-4 points, Right leg: 0-4 points 7. **Limb Ataxia**: 0-2 points 8. **Sensory**: 0-2 points 9. **Best Language**: 0-3 points 10. **Dysarthria**: 0-2 points 11. **Extinction and Inattention (Neglect)**: 0-2 points **NIHSS Score Interpretation** 0-1: No stroke symptoms. 1-4: Minor stroke. 5-15: Moderate stroke. 16-20: Moderate to severe stroke. 21-42: Severe stroke.

MODIFIED RANKIN SCALE (mRS): The Modified Rankin Scale (mRS) is used to measure the degree of disability or dependence in the daily activities of people who have suffered a stroke or other causes of neurological disability. It is widely used for assessing the long-term outcome of stroke patients. **mRS Score Components** 0: No symptoms at all. **1**: No significant disability despite symptoms; able to carry out all usual duties and activities. **2**: Slight disability; unable to carry out all previous activities but able to look after own affairs without assistance. **3**: Moderate disability; requiring some help, but able to walk without assistance. **4**: Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance. **5**: Severe disability; bedridden, incontinent, and requiring constant nursing care and attention. **6**: Dead. **mRS Score Interpretation -** MRS Score of 0-2 – Good functional outcome, MRS Score of 3-6 – Poor functional outcome

Statistical analysis

Data were stored in MS-Excel and analyzed using SPSS 24. A significance level of 0.05 or 0.01 was used for statistical tests. Parametric tests were used for continuous and normally distributed data, while non-parametric tests were used for categorical data.

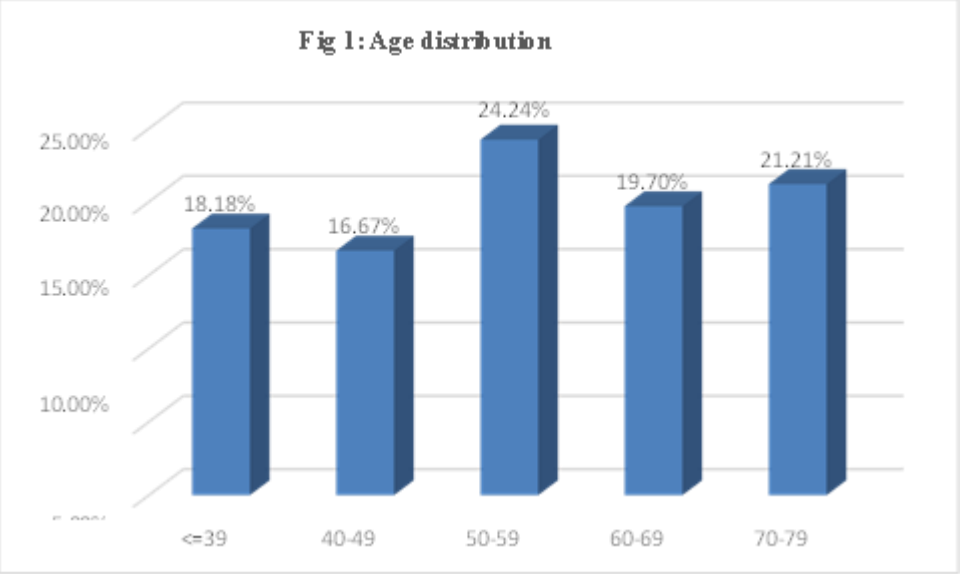
IV. Result

The table illustrates the age distribution in this study cohort focused on assessing the utility of the THRIVE score in stroke cases. The majority falls within the 50-59 age group (24.24%), followed closely by the 70-80 age range (21.21%). Notably, individuals aged 70 and above represent 21.21% of the population, contributing to insights into age-related patterns in stroke cases evaluated using the THRIVE score.

Age Distribution Of Patients

Table 1: Age Distribution of Patients

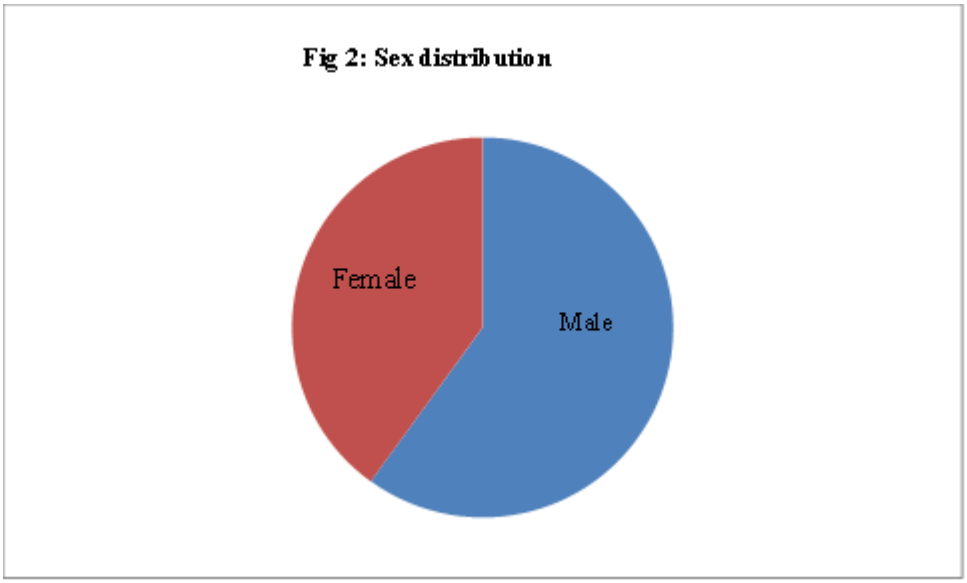
Age Group	Frequency (n=66)	Percentage
<=39	12	18.18%
40-49	11	16.67%
50-59	16	24.24%
60-69	13	19.70%
70-79	14	21.21%
Total	66	100%



Sex Distribution Of Patients

Table 2: Sex Distribution of Patients

Gender	Frequency (n=66)	Percentage (%)
Male	38	57.58%
Female	28	42.42%



Majority of the study participants are male, comprising 57.58% of the total, while females make up the remaining 42.42%.

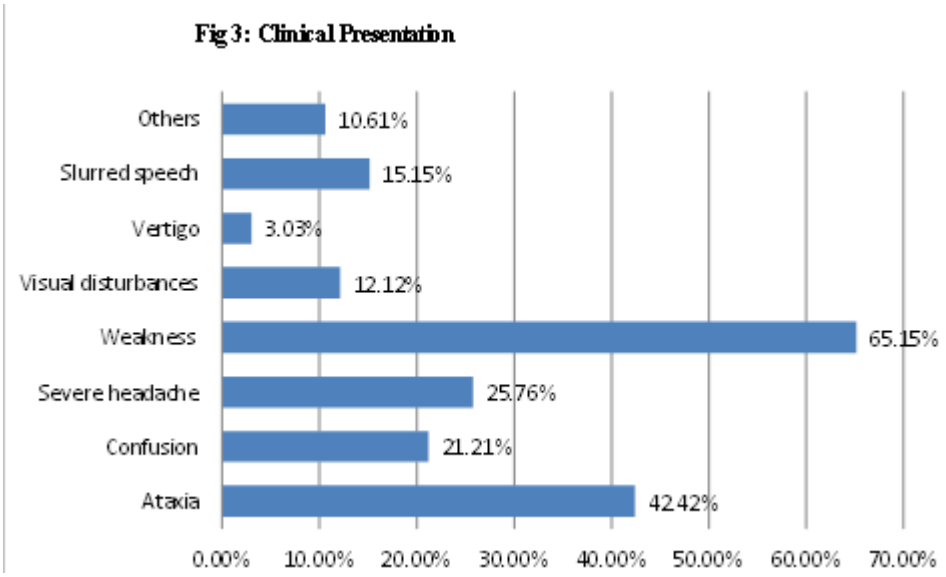
Clinical Presentation Of Patients

Table 3: Clinical Presentation of Study Subjects

Clinical features	Frequency	Percentage
Ataxia	28	42.42%
Confusion	14	21.21%
Severe headache	17	25.76%
Weakness of body parts (leg, hands, etc.)	43	65.15%
Visual disturbances	8	12.12%
Giddiness	2	3.03%
Vertigo	10	15.15%
Facial deviation	7	10.61%
Slurred speech	16	24.24%

Others	3	4.55%

The most common symptoms included weakness of body parts (65.15%), ataxia (42.42%), and slurred speech (24.24%). Other frequently reported symptoms were severe headache (25.76%) and vertigo (15.15%). Less common features included visual disturbances (12.12%), facial deviation (10.61%), confusion (21.21%), giddiness (3.03%), and a small percentage of other symptoms (4.55%). This distribution highlights that while certain symptoms like weakness and ataxia were prevalent, others were relatively rare among subjects.

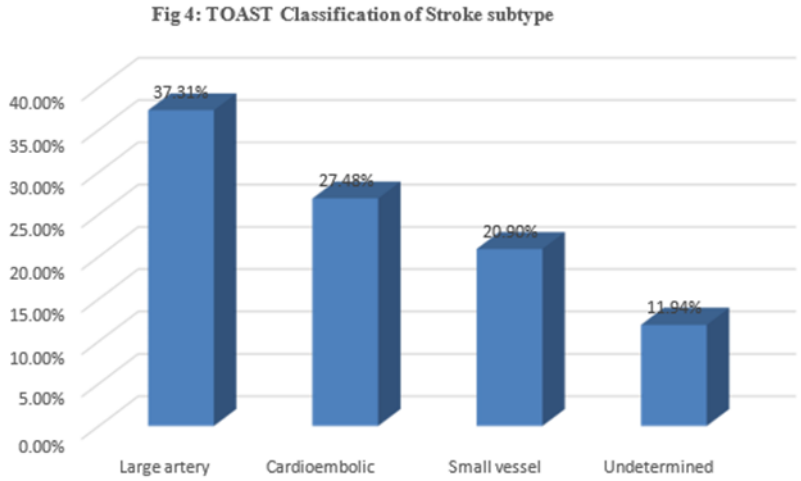


Toast Classification Of Stroke Subtype

Table 4: Toast Classification of Stroke Subtype Etiology among Study Subjects

TOAST Classification of Stroke subtype	Frequency (n=66)	Percentage (%)
Large artery atherosclerosis	25	37.31%
Cardioembolic	19	27.47%
Lacunar stroke secondary to small vessel disease	14	20.90%
Undetermined etiology	8	11.94%

The most common subtype is Large Artery Atherosclerosis, observed in 25 cases (37.31%). Cardioembolic follows, accounting for 19 cases (27.47%). Lacunar stroke secondary to small vessel disease is reported in 14 cases (20.90%), while the subtype with undetermined etiology is observed in 8 cases (11.94%).



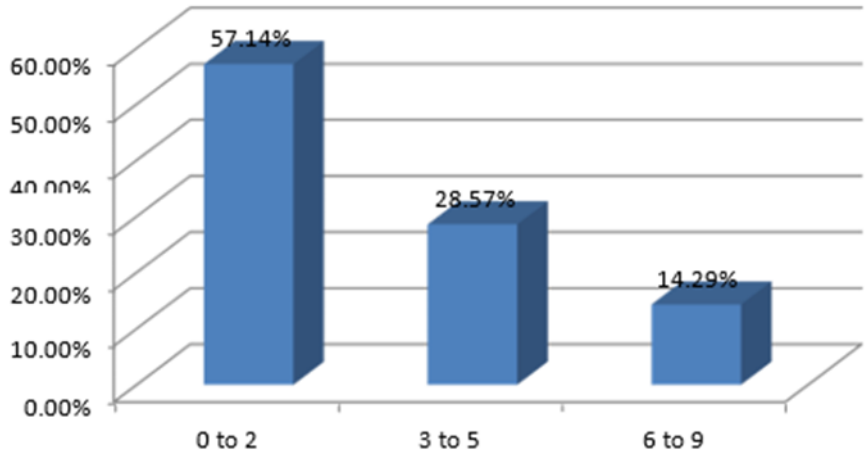
Clinical Scores Of Study Participants

Table 5: Clinical Scores of Study Participants

Clinical Score	Mean ± SD
THRIVE Score	2.82±1.90
NIHSS Scale	12.22±4.25
mRS Scale	2.28±1.34

The mean clinical scores of study participants, including THRIVE Score (2.82 ± 1.90), NIHSS Scale (12.22 ± 4.25), and mRS Scale (2.28 ± 1.34), provide insights into the overall health and stroke severity within the cohort.

Fig 5: THRIVE SCORE



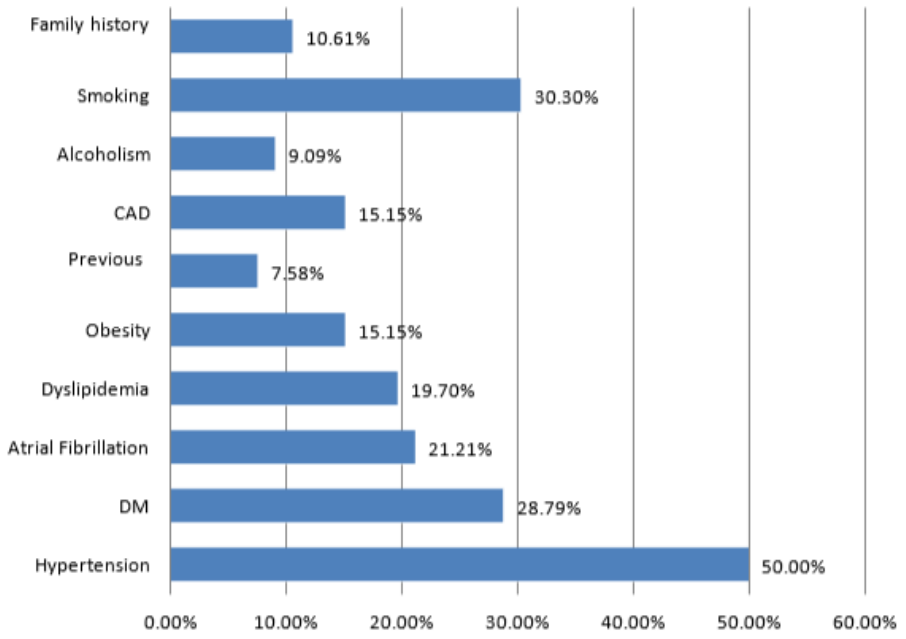
Risk Factors And Co-Morbidities

Table 6: Risk Factors and Co-morbidities among Stroke Patients

Risk factor/Comorbidity	Frequency (n)	Percentage (%)
Hypertension	33	50.00%
DM	19	28.79%
Atrial Fibrillation	14	21.21%
Dyslipidemia	13	19.70%
Obesity	10	15.15%
Previous stroke/TIA	5	7.58%
CAD	10	15.15%
Alcoholism	6	9.09%
Smoking	20	30.30%
Family history of stroke	7	10.61%

The table summarizes the risk factors and comorbidities among stroke patients in the study. The majority of patients had hypertension (50%), followed by diabetes mellitus (28.79%) and smoking (30.30%). Other notable factors include dyslipidemia (19.70%), atrial fibrillation (21.21%), coronary artery disease (15.15%), and obesity (15.15%). Additionally, a history of previous stroke or transient ischemic attack (TIA) was present in 7.58% of patients, while alcoholism and a family history of stroke were reported in 9.09% and 10.61% of cases, respectively.

Fig 6: Risk factor or Comorbidities



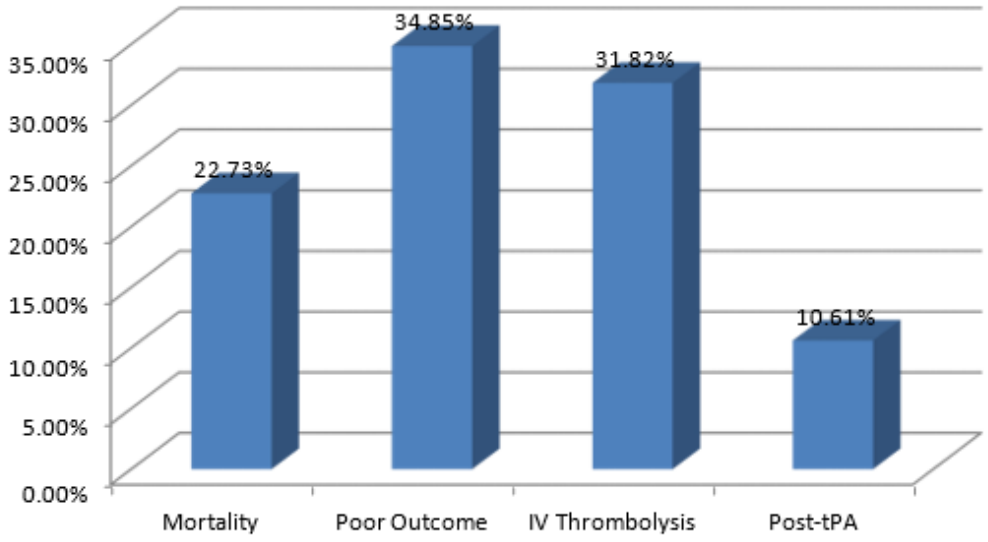
Outcome And Treatment Characteristics

Table 7: Outcome and Treatment Characteristics In Stroke Patients

Characteristics	Frequency (n=66)	Percentage (%)
Mortality	15	22.73%
Poor Outcome (mRS 3-6 at 90 days)	23	34.85%
Intravenous Thrombolysis	21	31.82%
Post-tPA hemorrhage	7	10.61%

The data on outcome and treatment characteristics in stroke patients (n=66) reveals that 22.73% experienced mortality, 34.85% had a poor outcome (mRS 3-6 at 90 days), 31.82% underwent intravenous thrombolysis, and 10.61% suffered post-tPA hemorrhage.

Fig 7: Outcome characteristics

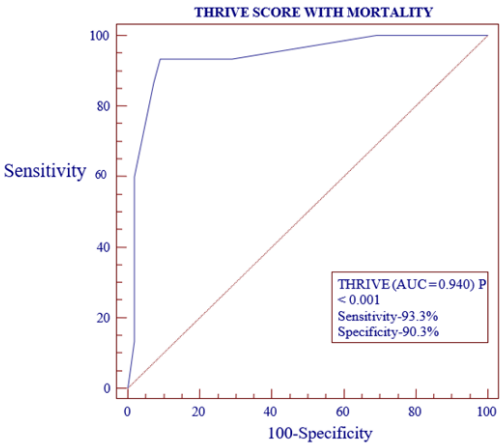


Predicting Mortality, Poor Outcome And Heamorrhagic Transformation Using Thrive Score

Table 8: Predicting Mortality Using THRIVE Score

Area under the ROC curve (AUC)	0.940000
Standard Error	0.0361
95% Confidence interval	0.856258 to 0.982717
z statistic	12.203
Significance level P (Area=0.5)	<0.0001
Sensitivity	93.3%
Specificity	90.3%

The Area under the ROC curve (AUC) is high at 0.94, indicating strong discriminatory accuracy. The statistical significance is robust, with a low p-value (<0.0001) based on the z statistic, supporting the reliability of the findings. The associated criterion for prediction (>3) is significant, and the 95% confidence intervals provide a precise estimate, enhancing the reliability of the predictive model.

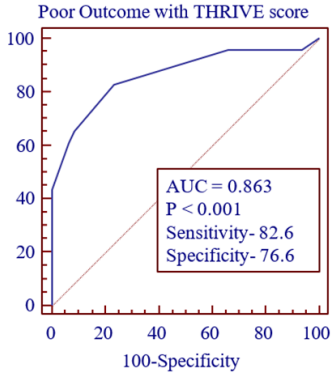


Predicting Poor Outcome Using Thrive Score

Table 9: Predicting Poor Outcome Using THRIVE Score

Area under the ROC curve (AUC)	0.863090
Standard Error	0.0521
95% Confidence interval	0.759968 to 0.933582
z statistic	6.963
Significance level P (Area=0.5)	<0.0001
Sensitivity	82.6%
Specificity	76.6%

The predictive performance of the THRIVE score for poor outcome was evaluated, revealing a robust area under the ROC curve (AUC) of 0.863090. The narrow standard error (0.0521) and a 95% confidence interval (0.759968 to 0.933582) further support the score's accuracy. The z statistic of 6.963 indicates a significant predictive ability ($p < 0.0001$), with a high sensitivity of 82.6% and specificity of 76.6%. These findings suggest that the THRIVE score demonstrates strong discriminative power in forecasting poor outcomes in stroke patients.

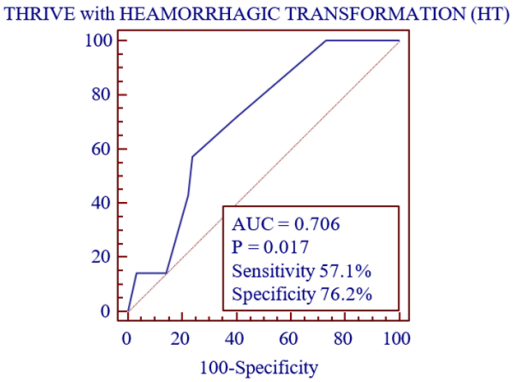


Predicting Hemorrhagic Using Thrive Score

Table 10: Predicting Hemorrhagic Transformation (HT) Using Thrive Score

Area under the ROC curve (AUC)	0.706349
Standard Error	0.0867
95% Confidence interval	0.585370 to 0.809202
z statistic	2.379
Significance level P (Area=0.5)	0.0174
Sensitivity	57.1%
Specificity	76.2%

The THRIVE score's predictive capability for hemorrhagic transformation is assessed, revealing an Area under the ROC curve (AUC) of 0.706, indicating moderate discriminatory accuracy. The statistical significance is supported by a p-value of 0.0174. Sensitivity is noted at 57.1%, and specificity at 76.2%, providing insights into the predictive performance of the THRIVE score for hemorrhagic transformation.



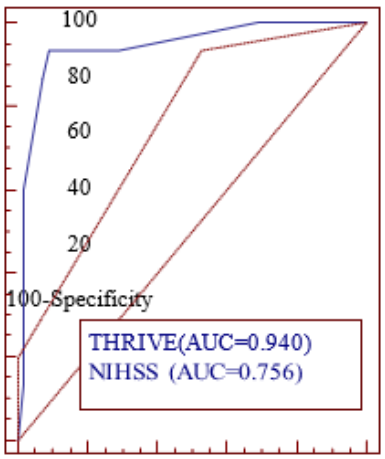
Comparison Of The Thrive Score And Nihss Score, Mortality, Poor Outcome Prediction By Roc Curve Analysis

Table 11: Comparison of the Thrive Score and NIHSS Score Mortality Prediction By ROC Curve analysis

THRIVE ~ NIHSS-Mortality prediction	
Difference between areas	0.184
Standard Error	0.0394
95% Confidence Interval	0.107 to 0.261
z statistic	4.676
Significance level	P < 0.0001

THRIVE and NIHSS were compared for mortality prediction, with THRIVE exhibiting superior performance (AUC = 0.940) compared to NIHSS (AUC = 0.756). The difference between the areas is statistically significant ($p < 0.0001$), favoring THRIVE.

Mortality

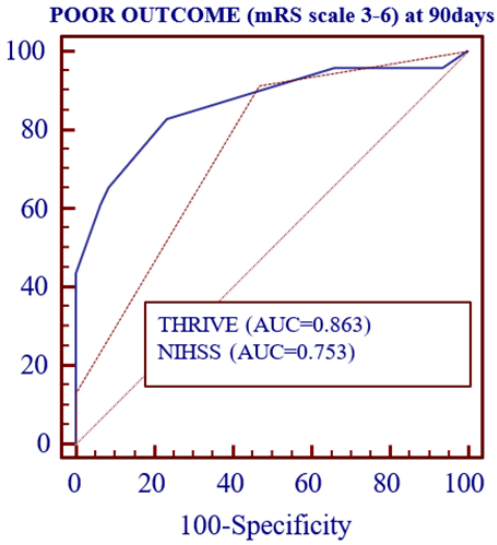


Comparision Of The Thrive Score And Nihss Poor Outcome

Table 12: Comparison of the THRIVE SCORE and NIHSS Score Poor Outcome Prediction

COMPARION OF THRIVE ~ NIHSS SCORE TO POOR OUTCOME (mRS 3-6) at 90 Days	
Difference between areas	0.110
Standard Error	0.0484
95% Confidence Interval	0.0153 to 0.205
z statistic	2.275
Significance level	P = 0.0229

The study compares THRIVE and NIHSS for predicting poor outcomes, revealing that THRIVE (AUC = 0.863) outperforms NIHSS (AUC = 0.753). The difference between their areas is statistically significant (p = 0.0229), with a confidence interval (0.0153 to 0.205) favoring THRIVE. This suggests that THRIVE is more effective in predicting poor outcomes compared to NIHSS.



Logistic Regression Analysis Of Mortality, Poor Outcome And Haemorrhagic Transformation At 3 Months

Table 13: Logistic Regression Analysis of Mortality At 3 Months

Variable	Coefficient	Std. Error	Odds Ratio	95% CI	P Value
NIHSS	-0.32058	0.69020	0.7257	0.1876 to 2.8073	0.6423
THRIVE	1.51247	0.44766	4.5379	1.8871 to 10.9121	0.0007
HT	2.49423	1.73643	12.1124	0.4029 to 364.1730	0.1509
Thrombolysis	-0.22692	1.42898	0.7970	0.0484 to 13.1166	0.8738
Constant	-6.90920				

The logistic regression analysis on mortality at 3 months revealed significant findings. The THRIVE score demonstrated a strong positive association (coefficient = 1.51247, p = 0.0007), indicating higher odds of mortality. NIHSS exhibited non-significant association (coefficient = -0.32058, p = 0.6423). Other variables (HT and Thrombolysis) showed non-significant associations.

Logistic Regression Analysis Of Poor Outcome At 3 Months

Table 14: Logistic Regression Analysis of Poor Outcome at 3 Months

Variable	Coefficient	Std. Error	Odds Ratio	95% CI	P Value
THRIVE	0.77447	0.26321	2.1694	1.2951 to 3.6341	0.0033
NIHSS	0.58586	0.47060	1.7965	0.7143 to 4.5188	0.2132
Thrombolysis	-1.13581	0.97483	0.3212	0.0475 to 2.1703	0.2440
HT	0.018244	1.35977	1.0184	0.0709 to 14.6348	0.9893
Constant	-3.7318				

The logistic regression analysis for poor outcome at 3 months indicated significant associations. The THRIVE score exhibited a positive association (coefficient = 0.77447, p = 0.0033), indicating higher odds of poor outcome. NIHSS and Thrombolysis showed non-significant associations, while HT also demonstrated a non- significant association.

Logistic Regression Analysis Of Haemorrhagic Transformation

Table 15: Logistic Regression Analysis of Hemorrhagic Transformation (HT)

Variable	Coefficient	Std. Error	Odds Ratio	95% CI	P Value
THRIVE	-1.26888	1.15923	0.2811	0.0290 to 2.7271	0.2737
NIHSS	2.64631	1.48368	14.1019	0.7697 to 258.3533	0.0745
HTN	4.35267	2.04401	77.6853	1.4140 to 4268.1268	0.0332
DM	2.91957	1.90032	18.5332	0.4471 to 768.3137	0.1245
AF	-18.19257	2016.15400	0.0000	None	0.9928
Constant	-5.8055				

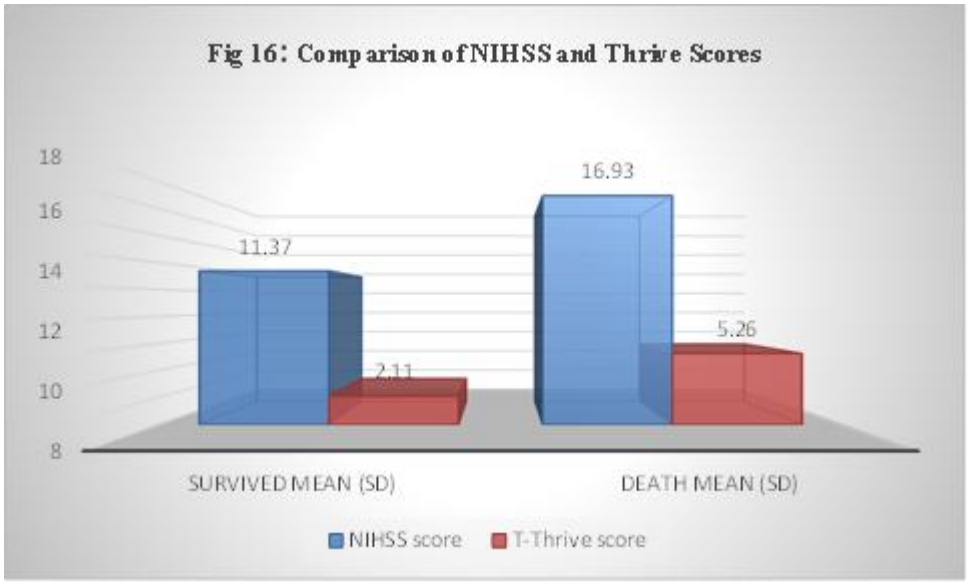
The logistic regression analysis for hemorrhagic transformation revealed mixed results. THRIVE, NIHSS, HTN, and DM exhibited non-significant associations with odds ratios of 0.2811, 14.1019, 77.6853, and 18.5332, respectively. However, AF displayed an undefined association. The p-values for THRIVE, NIHSS, HTN, DM, and AF were 0.2737, 0.0745, 0.0332, 0.1245, and 0.9928, respectively.

Comparison Of Nihss And Thrive Scores Between Survived And Death Groups

Table 16: Comparison of NIHSS and Thrive Scores Between Survived and Death Groups

Score	Survived Mean (SD)	Death Mean (SD)	Survived Frequency (%)	Death Frequency (%)	Test	P- value
NIHSS score	11.37 ± 3.62	16.93 ± 4.54	51 (77.27%)	15 (22.73%)	t-test	0.0003
Thrive score	2.11 ± 1.28	5.26 ± 1.16	51 (77.27%)	15 (22.73%)	t-test	0.0001

In this study, we compared NIHSS and Thrive scores between patients who survived and those who died. The mean NIHSS score for the survived group was 11.37 (SD = 3.62), while for the death group it was 16.93 (SD = 4.54), with a significant p-value of 0.0003. Similarly, the mean Thrive score for the survived group was 2.11 (SD = 1.28) compared to 5.26 (SD = 1.16) for the death group, also showing a significant difference with a p-value of 0.0001. These results suggest that higher NIHSS and Thrive scores are associated with higher mortality rates.



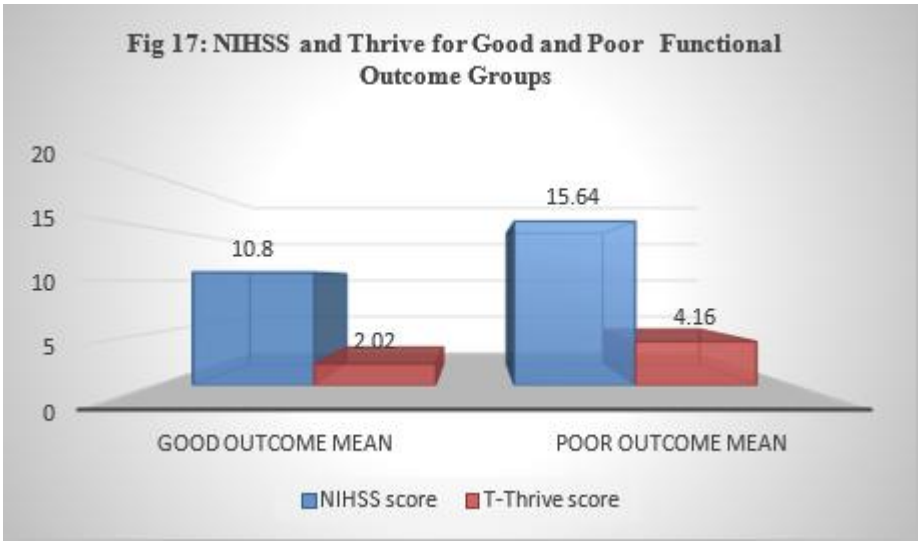
NIHSS And Thrive For Good And Poor Functional Outcome Groups

Table 17: NIHSS and Thrive for Good and Poor Functional Outcome Groups

Scores	Good Outcome (N=Freq, %)	Poor Outcome (N=Freq, %)	Good Outcome Mean (SD)	Poor Outcome Mean (SD)	Test	P-value
NIHSS score	41 (62.12%)	25 (37.88%)	10.80 (3.44)	15.64 (4.41)	t-test	0.0021
Thrive score	41 (62.12%)	25 (37.88%)	2.02 (1.21)	4.16 (1.89)	t-test	0.0013

In this study, the NIHSS and Thrive scores were compared between good and poor outcome groups. The good outcome group, comprising 62.12% (N=41) of the patients, had a mean NIHSS score of 10.80 (SD = 3.44), while the poor outcome group, comprising 37.88% (N=25), had a significantly higher mean NIHSS score of

15.64 (SD = 4.41) with a p-value of 0.0021. Similarly, the Thrive score for the good outcome group was 2.02 (SD = 1.21) compared to 4.16 (SD = 1.89) for the poor outcome group, with a p-value of 0.0013. These results indicate that higher NIHSS and Thrive scores are associated with poorer outcomes.



V. Discussion

This study underscores the efficacy of the THRIVE score in accurately predicting 90-day clinical outcomes in patients with acute ischemic stroke. Particularly focused on the non-modifiable predictors of age, clinical stroke severity (NIHSS), and key comorbidities (HTN, DM, and AF), the THRIVE score consistently outperformed the NIHSS score in forecasting outcomes. This predictive capability remained robust across diverse acute ischemic stroke treatment scenarios, encompassing IV tPA treatment and instances without acute stroke treatment. Notably, the THRIVE score exhibited a remarkable independence from the impact of recanalization therapy on outcomes, further affirming its reliability and versatility as a predictive tool in ischemic stroke scenarios.

In this study, the age distribution of stroke patients follows a pattern observed in various studies[16,17], with a concentration in the 50-69 age range. . The majority falls within the 50-59 age group (24.24%), followed closely by the 70-79 age range (21.21%). Notably, individuals aged 70 and above represent 21.21% of the population, contributing to insights into age-related patterns in stroke cases evaluated using the THRIVE score.

Analyzing gender distribution, the study reveals a higher prevalence of male participants, comprising 57.58% of the total, while females constitute the remaining 42.42%. This aligns with trends observed in other studies such as Alex Förster et al.[87], who reported 53.2% men and 46.8% women among AIS patients. Similarly, Rexrode et al.[17] noted a higher incidence of stroke in males in their respective cohorts. Notably, female-specific risk factors, including those directly modifiable and aspects like reproductive lifespan, may contribute to the observed differences. For instance, oral contraceptive use in young women and menopausal hormone therapy have been associated with stroke risk, emphasizing the need for nuanced risk prediction models that consider gender-specific factors.[17]

In this study involving 66 stroke patients, the predominant symptoms reported align with established patterns in stroke presentations. The most common symptoms included weakness of body parts (65.15%), ataxia (42.42%), and slurred speech (24.24%). Other frequently reported symptoms were severe headache (25.76%) and vertigo (15.15%). Less common features included visual disturbances (12.12%), facial deviation (10.61%), confusion (21.21%), giddiness (3.03%), and a small percentage of other symptoms (4.55%). These findings resonate with the widely recognized spectrum of stroke symptoms, encompassing both motor deficits and various sensory and cognitive manifestations. The diversity in symptom presentation underscores the complexity of stroke and the importance of recognizing a broad range of clinical signs for timely and accurate diagnosis.[18,19]

In this study involving 66 stroke patients, the distribution of stroke subtypes reveals a varied landscape of etiologies. The most common subtype is Large Artery Atherosclerosis, observed in 25 cases (37.31%). Cardioembolic follows, accounting for 19 cases (27.47%). Lacunar stroke secondary to small vessel disease is reported in 14 cases (20.90%), while the subtype with undetermined etiology is observed in 8 cases (11.94%). These findings align with similar studies, such as Tai et al.[18], which also identified large artery atherosclerosis as a predominant subtype, and Waqas et al.[20], emphasizing the prevalence of large vessel occlusion (LVO). Shihmanter et al.'s[21] TOAST classification further validates the observations, showcasing the multifactorial nature

of stroke etiology. The diversity in stroke subtypes reinforces the need for tailored therapeutic approaches and highlights the intricate interplay of vascular and embolic factors in stroke pathophysiology.

The mean clinical scores of study participants, including THRIVE Score (2.82 ± 1.90), NIHSS Scale (12.22 ± 4.25), and mRS Scale (2.28 ± 1.34), provide insights into the overall health and stroke severity within the cohort. These scores collectively offer a comprehensive snapshot of the participants' health status and the severity of stroke within the cohort. The THRIVE Score, incorporating various clinical parameters, aids in predicting outcomes, while the NIHSS Scale provides a quantifiable measure of neurological impairment. The mRS Scale further assesses functional independence post-stroke. This aligns with the findings of similar studies, [4,7,8] emphasizing the importance of these scores in gauging the clinical landscape of stroke patients. Our data, when considered alongside existing literature, contributes to the broader understanding of stroke severity and aids in benchmarking the health status of our study cohort.[5,6]

The majority of patients had hypertension (50%), followed by diabetes mellitus (28.79%) and smoking (30.30%). Other notable factors include dyslipidemia (19.70%), atrial fibrillation (21.21%), coronary artery disease (15.15%), and obesity (15.15%). Additionally, a history of previous stroke or transient ischemic attack (TIA) was present in 7.58% of patients, while alcoholism and a family history of stroke were reported in 9.09% and 10.61% of cases, respectively. Comparing findings of this study with Brechtel et al.'s[22] exploration of gender differences in patients with borderline cholesterol, women exhibited higher rates of depression, dyslipidemia, heart failure, and hypertension. The reported gender differences in comorbidities align with observations made by Rexrode et al.[17], suggesting that women may be more susceptible to certain stroke risk factors, potentially contributing to their higher likelihood of severe strokes compared to men. The study by Shihmanter et al.[21] study results revealed significant differences in the prevalence of certain comorbidities between two groups. Hypertension was more common in Group A (53.8%) compared to Group B (85.7). Similarly, atrial fibrillation was more prevalent in Group B (35.7%) than in Group A (15.4%), although this difference did not reach statistical significance ($p = 0.124$). Diabetes mellitus, previous stroke or TIA, coronary artery disease, and drinking did not show statistically significant differences between the groups ($p > 0.05$). These findings align with Chen et al.'s[23] study, emphasizing the importance of hypertension as a major contributor to stroke risk and suggesting a potential association between atrial fibrillation and stroke. The complex relationship between comorbidities and stroke underscores the importance of a comprehensive and individualized approach to stroke prevention and management.

In this study involving 66 stroke patients, the data on outcome and treatment characteristics reveals intriguing patterns. The data on outcome and treatment characteristics in stroke patients (n=66) reveals that 22.73% experienced mortality, 34.85% had a poor outcome (mRS 3-6 at 90 days), 31.82% underwent intravenous thrombolysis, and 10.61% suffered post-tPA hemorrhage. Comparing the findings with Tai et al.'s[11] study, the results are in harmony with the established safety profile of stroke thrombolysis. Within the study cohort, 44.4% achieved an excellent outcome (mRS score 0–1 at three months), aligning with the range observed in other Asian datasets (26.1%–59.0%).[34,35] Correspondingly, European and Canadian studies reported comparable outcomes, with 31%–53% achieving an mRS score of 0–1.[36,37] However, it's noteworthy that the three-month mortality rate (22.73%) falls higher than the reported range of 6.5%–15.0% in existing literature. Interestingly, the in- hospital mortality rate in this study surpassed that reported in Singapore (3.7%) and a multi-center study with a one-week mortality rate of 1.5%.[36] The data on outcome and treatment characteristics in stroke patients (n=66) reveals that 22.73% experienced mortality, 34.85% had a poor outcome (mRS 3-6 at 90 days), 31.82% underwent intravenous thrombolysis, and 10.61% suffered post-tPA hemorrhage. These results emphasize the need for nuanced interpretations, considering regional variations and potential contributing factors that influence stroke outcomes. It is imperative to delve into these differences for a comprehensive understanding of stroke management and to guide future research and interventions.

In this study involving 66 stroke patients, the THRIVE score emerged as a robust predictor for clinical outcomes. The Area under the ROC curve (AUC) for poor outcomes was 0.863, demonstrating its strong discriminative power. Moreover, in predicting hemorrhagic transformation, the THRIVE score exhibited moderate accuracy with an AUC of 0.706. Comparisons with NIHSS in mortality prediction consistently favored THRIVE. For overall mortality prediction, THRIVE outperformed NIHSS (AUC = 0.940 vs. 0.756), and in predicting poor outcomes, THRIVE excelled (AUC = 0.863 vs. 0.753). These differences were statistically significant, supporting the superior predictive efficacy of THRIVE.

Notably, findings in this study align with the study by Flint et al.[26], where THRIVE showed strong predictability for clinical outcomes, mortality, and intracerebral hemorrhage after tPA. Matsumoto et al.'s[27] study reinforced THRIVE's predictive prowess, positioning it favorably against other scoring systems. The study by Atam et al.[38] provided additional insight, highlighting the independent predictive value of stress hyperglycemia, with THRIVE scores of 6 or above predicting mortality in a majority of non-survivors. Flint et al.'s[8] recent findings support the efficacy of Endovascular Treatment (EVT) in improving outcomes, with EVT consistently outperforming the control group across age, NIHSS, and THRIVE-c good outcome prediction. Moreover, models

integrating THRIVE elements with EVT demonstrated robust predictive performance, emphasizing the score's relevance in guiding treatment decisions.

Akarsu et al.'s[28] study emphasizes the importance of collateral presence and imaging scores (CT-ASPECT, BTA-ASPECT, BATMAN) in predicting clinical outcomes. Notably, better collateral presence was associated with favorable outcomes, reinforcing the multifaceted nature of predictive factors. Chen et al.'s[29] comprehensive evaluation highlights the THRIVE score's significant association with poor functional outcomes and all-cause mortality. The THRIVE score consistently outperformed NIHSS in predicting these outcomes, reinforcing its superiority in prognostic accuracy.

A study by Chen et al.'s[29] study provides valuable insights into the association between the THRIVE score and clinical outcomes in acute ischemic stroke (AIS) patients with basilar artery occlusion (BAO) undergoing thrombectomy treatment. The findings indicate that a higher THRIVE score is significantly linked to poor functional outcomes and all-cause mortality, reinforcing the score's prognostic value. Importantly, the THRIVE score outperformed the NIHSS score in predicting poor functional outcomes and all-cause mortality, as evidenced by larger C-statistics and favorable sensitivity and specificity values. In comparison, Forster et al.'s[16]study delves into gender-specific variations in stroke subtypes and outcomes. Men exhibited a higher prevalence of internal carotid artery disease, border zone/small embolic, and lacunar strokes, while women had a higher percentage of large territorial strokes and atrial fibrillation. Despite these subtype differences, baseline National Institute of Health Stroke Scale (NIHSS) scores, NIHSS scores at discharge, and 3-month outcomes measured by the modified Rankin Scale were similar between genders.

The THRIVE score's versatile applicability across various acute stroke treatments, as evidenced by studies like Flint et al.[16] establishes its credibility in predicting long-term prognosis. In the context of endovascular stent treatment (EST), the THRIVE score has been validated in trials such as TREVO-2, SWIFT, and STAR, demonstrating its consistency in forecasting outcomes post-EST[16]

Comparatively, the NIHSS score has been a longstanding tool for assessing ischemic stroke severity. However, Wang's study[32] and our data suggest that the THRIVE score surpasses the NIHSS score in predicting outcomes. Our ROC curve analysis demonstrates the superior predictive value of the THRIVE score for poor prognosis and mortality at 90 days compared to the NIHSS score.[13] Our data, derived from logistic regression analyses, provides additional insights. The THRIVE score consistently exhibits significant positive associations with mortality and poor outcomes at 3 months. In contrast, the NIHSS score, Thrombolysis, and other variables demonstrate non-significant associations in various analyses.[10]

This study demonstrates that higher NIHSS and THRIVE scores are significantly associated with poorer outcomes in stroke patients, with the good outcome group showing a mean NIHSS score of 10.80 and THRIVE score of 2.02, compared to the poor outcome group's mean NIHSS score of 15.64 and THRIVE score of 4.16. These findings are consistent with several other studies. Krongsut et al.[33] found that patients with in-hospital mortality (IHM) had significantly higher NIHSS scores at admission (18.6) compared to survivors (11.1), emphasizing the role of NIHSS in predicting outcomes. Similarly, Flint et al.[8] validated the THRIVE score's predictive performance in patients undergoing endovascular stroke treatment (EVT), showing significant outcome improvements across NIHSS categories with EVT. Atam et al.[38] also reported that stress hyperglycemia was associated with higher NIHSS scores, indicating more severe strokes and poorer outcomes, reflected by higher THRIVE scores among different diabetic and non-diabetic groups.

Moreover, Eren et al.[39] analyzed female stroke patients and found that higher NIHSS and THRIVE scores were linked to poor outcomes, including increased in-hospital mortality and dependency at discharge. This aligns with our findings, reinforcing the predictive value of these scores across diverse patient populations. Collectively, these studies corroborate our results, highlighting the importance of NIHSS and THRIVE scores in clinical practice for assessing stroke severity and prognosis.

In this study, the mean NIHSS and THRIVE scores were significantly higher in patients who died compared to those who survived. Specifically, the mean NIHSS score for survivors was 11.37, while for those who died, it was 16.93, with a p-value of 0.0003. Similarly, the mean THRIVE score for survivors was 2.11 compared to 5.26 for those who died, with a p-value of 0.0001. These findings align with those of Krongsut et al.[116], who reported higher NIHSS scores in patients with in-hospital mortality (18.6) compared to survivors (11.1). Flint et al.[8] also validated the THRIVE score's predictive accuracy, demonstrating significant outcome improvements with endovascular treatment across NIHSS categories. Atam et al[38]. found that stress hyperglycemia correlated with higher NIHSS scores and worse outcomes, further underscoring the relationship between higher scores and increased severity and mortality.

Additionally, Eren et al.[39] observed that female stroke patients with higher NIHSS and THRIVE scores experienced worse outcomes, including increased mortality and dependency at discharge. This is consistent with our findings, reinforcing the predictive value of these scores in various patient populations. Collectively, these studies support the notion that higher NIHSS and THRIVE scores are robust indicators of higher mortality rates and worse clinical outcomes.

This study underscores the significant role of age, gender, socioeconomic status, comorbidities, and stroke subtypes in shaping the clinical landscape of acute ischemic stroke. The THRIVE score emerged as a robust predictor, offering valuable insights into mortality, poor outcomes, and hemorrhagic transformations post-thrombolysis. Furthermore, our findings provide evidence supporting the superiority of the THRIVE score over the NIHSS score in prognostic accuracy. The versatile applicability of the THRIVE score across various acute stroke treatments underscores its credibility in predicting long-term prognosis and guiding treatment decisions. Overall, our study contributes to the growing body of evidence supporting the clinical utility of the THRIVE score in acute ischemic stroke management, emphasizing its potential to optimize patient care and improve outcomes.

VI. Conclusion

This study underscores the compelling utility of the Totaled Health Risks in Vascular Events (THRIVE) score as a reliable and straightforward tool for predicting outcomes in Acute Ischemic Stroke (AIS) patients.

The inclusion of non-modifiable factors such as age, National Institutes of Health Stroke Scale (NIHSS), and comorbidities like hypertension, diabetes mellitus, and atrial fibrillation renders the THRIVE score particularly effective.

Its simplicity, independence from laboratory or radiological parameters, and consistent performance across diverse treatment scenarios make it a valuable asset in assessing functional outcomes, morbidity and mortality in Acute Ischemic Stroke patients.

The THRIVE score's superiority in predicting hemorrhagic transformation and its comparative advantage over other scoring systems emphasize its clinical significance, offering clinicians an accessible and robust tool for prognosis assessment in the challenging landscape of acute ischemic stroke.

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