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# Association of triglyceride glucose index with clinical outcomes in ischemic stroke: a retrospective study

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## Abstract

**Background** Stroke is a major cause of illness, death, and long-term disability and a major health concern worldwide. Experts consider insulin resistance (IR), a defining feature of the metabolic syndrome and a significant risk factor for stroke. Insulin resistance, or IR, is common among stroke patients. The triglyceride-glucose (TYG) index's relevance to both lipotoxicity and glucotoxicity has led to its proposal as an alternative indicator of IR.

**Aim** Examining the connection between elevated TYG INDEX scores and worse clinical outcomes in ischemic stroke patients is the main goal. Finding out how often bad outcomes (recurrence and all-cause death) are in ischemic stroke patients is the secondary goal.

**Method** This was a retrospective observational study that involved patients admitted to the 850-bed Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, a tertiary care teaching hospital located in the Krishna district of Andhra Pradesh (India). The study was conducted over a period of six months. All the 95 patients who satisfied the eligibility criteria were included. The patients' TYG INDEX values were first determined and patients with ischemic stroke who had elevated TYG INDEX values were then compared for clinical outcomes including recurrence and all-cause death with ischemic patients with normal TYG INDEX.

**Results** In this study, the total cholesterol of the patients (mean ± SD) was 165.01 ± 51.5 mg/dL; Triglycerides was 157.031 ± 98.9 mg/dL; HDL-c was 37.253 ± 5.52 mg/dl; LDL-c was 107 ± 48.3 mg/Dl; and FBS was 153.74 ± 71.52 mg/dL. The chi-square test showed that only FBS, Triglyceride, and Total cholesterol were significantly associated with TYG INDEX whereas other variables like age, LDL, and HDL were not. There was no significant association between the TYG INDEX and clinical outcomes of ischemic stroke. In both groups of patients, risk and no risk TYG INDEX values, the mRS score showed variable and unpredictable relationship with the TYG INDEX.

**Conclusion** Contrary to the few studies that discovered one, our research leads us to the conclusion that there may not be a relevant association between the TYG INDEX and clinical results in patients with ischemic stroke.

**Keywords** Triglyceride glucose index, Ischemic stroke, Mortality, Recurrence

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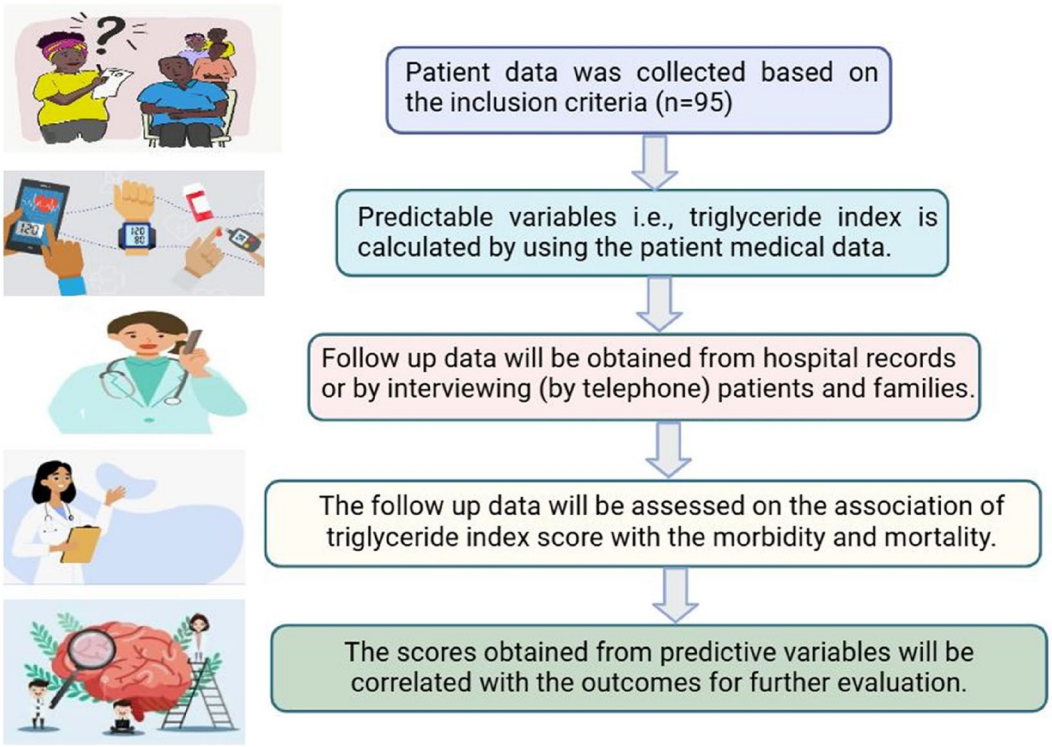
**Graphical Abstract**




## Impact statements

- The previous reports about triglyceride glucose index (*TYG INDEX*) link with clinical outcomes in ischemic stroke patients requires a scientific demonstration of its potential to predict patient outcomes and improve specific therapies.
- This study investigated the association between the *TYG INDEX* and clinical outcomes in ischemic stroke patients.
- The findings of the current study showed no significant association between *TYG INDEX* and clinical outcomes in ischemic stroke patients.
- Our finding highlights the need for a holistic approach in the management of ischemic stroke instead of relying on triglyceride glucose index as a marker role.

## Introduction

A stroke, according to the World Health Organization, is a medical condition characterized by quickly developing clinical signs of a focal (or global, in the case of a coma) impairment of brain function that lasts longer than twenty-four hours or causes death and for which there is no known underlying cause other than vascular origin. The three primary kinds of stroke are subarachnoid haemorrhage, haemorrhagic stroke, and ischemic stroke. A haemorrhagic stroke is most common stroke (more than 85%) was produced by a blood vessel rupture, allowing blood to enter the cerebral cavity, whereas an ischemic stroke (less than or equal 15%) is caused by a blood vessel obstruction, reducing blood flow to the brain [1–6].

A Transient Ischemic Attack (TIA), also known as a "mini-stroke," occurs when there is a temporary reduction in blood flow to the brain, which, unlike a full stroke, does not result in permanent brain damage [7]. However, a TIA serves as a critical warning of a potential future stroke, indicating the need for immediate preventive measures to reduce risk. Several factors contribute to an increased likelihood of strokes, ranging from lifestyle habits and medical conditions to demographic variables [8]. One significant risk factor is high cholesterol,

which leads to the buildup of fatty deposits (plaque) in the arteries, a condition known as atherosclerosis [9]. This can narrow arteries and obstruct blood flow to the brain, significantly raising the risk of ischemic strokes and TIAs. Similarly, diabetes plays a critical role, as it damages blood vessels and makes them more susceptible to blockages, especially when blood sugar levels remain uncontrolled over time [10]. Smoking is another major risk factor that accelerates atherosclerosis and damages blood vessels, while also raising blood pressure. The chemicals in tobacco smoke can cause the blood to thicken and form clots in veins and arteries [11]. Additionally, obesity increases the likelihood of related conditions like high blood pressure, high cholesterol, and diabetes, which all contribute to stroke risk [12]. Physical inactivity compounds these risks, as it is closely linked to obesity, hypertension, and diabetes [13]. Engaging in regular physical activity, by contrast, helps lower blood pressure, improve cholesterol levels, and promote healthy blood circulation, reducing the overall risk of stroke [14]. Age is another non-modifiable factor, as the likelihood of stroke increases after the age of 55 due to the natural wear and tear on the cardiovascular system. Having a family history of stroke can also increase a person's risk, as genetic factors affecting blood pressure, cholesterol, and diabetes may be inherited [15, 16]. Gender also plays a role; although men have a higher overall risk of stroke, women tend to experience more severe outcomes when they do have one [17, 18]. Ethnicity is a significant factor, with African Americans and Hispanics having a higher risk of stroke, in part due to higher rates of hypertension, diabetes, and obesity within these populations [19].

In addition to these risk factors, certain medical conditions can increase stroke risk. Cardiovascular diseases, including heart failure, cardiomyopathy, and coronary artery disease, make clot formation more likely and contribute significantly to stroke risk [20]. Sleep apnea, a condition where breathing stops intermittently during sleep, can lead to hypertension and other cardiovascular problems, further raising the chances of a stroke. A history of a previous stroke or TIA is one of the strongest indicators of future stroke risk, making it essential for individuals who have experienced either to follow strict medical management or make necessary lifestyle changes [21]. Lifestyle and behavioural choices also heavily influence stroke risk. Excessive alcohol consumption raises blood pressure, a leading cause of strokes, and can contribute to irregular heart rhythms, which increase the likelihood of blood clots forming [22]. Similarly, the use of illicit drugs such as cocaine can cause blood vessels to narrow, reducing blood flow to the brain, and can also result in abnormal blood clotting [23]. An unhealthy diet, particularly one high in salt, saturated fats, and trans fats, can contribute to high blood pressure and atherosclerosis, increasing stroke risk further. Conversely, diets rich in fruits, vegetables, and whole grains can help mitigate this risk.To reduce the likelihood of stroke, it is essential to manage underlying medical conditions such as high blood pressure, diabetes, and heart disease. Adopting healthier lifestyle habits—such as regular exercise, a balanced diet, smoking cessation, and limited alcohol intake—can significantly lower stroke risk [24]. Medications for conditions like atrial fibrillation or high cholesterol should be taken as prescribed to prevent the formation of blood clots and other cardiovascular complications [25, 26]. Recognizing the early warning signs of stroke, such as sudden numbness, weakness on one side of the body, confusion, trouble speaking, and vision problems, is also crucial in ensuring timely medical intervention, which can minimize the long-term impacts of a stroke [27].

Depending on where the blood was spilled, the haemorrhagic stroke can be characterized as intra cerebral or subarachnoid haemorrhage. Ischemic stroke accounts for 60–80% of all stroke cases [28]. In the United States, the statistics are slightly different: 87% of strokes are ischemic, 10% are haemorrhagic, and approximately 3% are subarachnoid haemorrhages [29, 30]. While stroke incidence statistics are rare in India, they can be extrapolated from Western data. In 2001, Banerjee et al. assessed the annual incidence rate and crude prevalence rate of stroke in India to be 36 per 100,000 people. Women had considerably higher age-adjusted prevalence rates (564/100,000 vs. 196/100,000) and incidence rates (204/100,000 vs. 36/100,000) compared to men [31–34].

Diabetes (30%), high blood pressure (38%), and smoking (40%) are the three most common risk factors for acute coronary syndrome (ACS), the leading cause of death worldwide. Given the aforementioned statistics, as well as the fact that ACS and stroke share many risk factors, we can legitimately conclude that India has a relatively high stroke incidence [35].

Stroke, one of the leading causes of insulin resistance, is a defining hallmark of the metabolic syndrome. Patients who have had a stroke typically have insulin resistance (IR). Previous study has shown that IR promotes atherosclerosis, produces hemodynamic disturbances, and accelerates platelet aggregation, adhesion, and activation, potentially leading to stroke recurrence in persons who have previously had an ischemic stroke (IS) [36].

There are two methods for performing IR glucose clamp testing: Using the hyperglycaemic clamp technique, one may measure the sensitivity of beta cells to glucose, and the euglyceamic insulin clamp technique is for measuring the insulin sensitivity of peripheral cells. These techniques, which are regarded as the most

accurate way to evaluate insulin resistance (IR), rely on steady-state glucose clearance measures and continuous insulin infusion [37]. However, because of the time and financial costs, this strategy is only partially applicable. The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) is an alternate assessment approach; however, it is also expensive because it requires insulin measurement. Previous studies have demonstrated that glucotoxicity and lipotoxicity are important factors in IR modulation. The TYG INDEX has been recommended as a replacement for the IR indication due to its relationship to lipotoxicity and glucotoxicity. TYG INDEX was proposed as a good surrogate marker of insulin resistance. It was calculated as ln (fasting triglyceride [mg/dL] fasting glucose [mg/dL]/2). The usual range of the TYG INDEX was 4.080 to 4.808 [38].

There are only a few studies currently linking the TYG INDEX to stroke. A fresh cross-sectional investigation revealed that in the general population, greater values of the TYG INDEX were related to an advanced risk of ischemic stroke.

## Methods

This observational study was conducted at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, an 850-bed tertiary care teaching hospital located in Chinnaoutpalli, Krishna district, Andhra Pradesh, within the Gannavaram Mandal region. The study spanned a six-month period, with data collected retrospectively. A total of 95 patients who met the predefined inclusion criteria participated in the study. These patients were admitted to the hospital during the specified timeframe, and their medical records were reviewed and analysed as part of the study's objectives.

### Study setting and period

This retrospective observational study involved patients admitted to the 850-bed Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, a tertiary care teaching hospital situated in the Krishna district of Andhra Pradesh, India. The study was conducted over a six-month period, during which patient data was collected and analyzed to meet the study's objectives.

### Study population

All patients aged 18 years and older who met the inclusion criteria were considered for the study. Participants were required to have brain CT or MRI imaging results confirming an ischemic stroke diagnosis, along with an estimated glomerular filtration rate (eGFR) of 60 ml/min/1.73 $m^2$ or higher at the time of admission. Patients who had been using triglyceride-lowering medications or statins prior to the stroke were excluded from the study. Additionally, individuals with a life expectancy of less than one year or those with severe physical disabilities that prevented them from providing written informed consent were also excluded.

### Sample size and sampling technique

A total of 95 patients, aged 18 years and older, who met the established eligibility criteria, were included in the study. These patients presented at the hospital during the designated study period and were carefully evaluated for inclusion based on the study's criteria. Only those who satisfied all relevant conditions, including age and specific medical requirements, were admitted into the research cohort, ensuring a targeted and consistent sample for analysis.

### Data collection tools and procedures

A structured data collection form was utilized to gather comprehensive information from the patients' clinical records. This included detailed demographic data such as age and sex, along with social history factors like smoking habits and alcohol consumption. Additionally, family medical history and any existing comorbidities were documented. Patient diagnostic assessments were also recorded as part of the clinical evaluation. Based on this collected information, the Triglyceride Glucose (TyG) index was calculated for each patient. Following this, outcome data were obtained either through hospital records or by conducting interviews with the patients and their families via telephone. These interviews were aimed at identifying major clinical outcomes, including the occurrence of recurrent strokes and all-cause mortality, to evaluate the long-term health impact on the participants.

The Modified Rankin Scale was employed to analyze the clinical outcomes of the study. The Modified Rankin Scale (mRS) is a key instrument used to assess the level of disability or dependence in individuals following a stroke or other significant neurological conditions [39].

It evaluates the degree of functional impairment by categorizing patients into one of six levels: Level- I: No Symptoms (Score 0), The patient experiences no symptoms and is fully functional. Level II- Slight Disability (Score 1): The patient has minor disability but can perform all usual activities with some difficulty. Level-III, Moderate Disability (Score 2): The patient requires some assistance but is able to walk independently. Level-IV, Moderately Severe Disability (Score 3): The patient needs help with daily activities and cannot walk without assistance. Level-V, Severe Disability (Score 4): The patient is bedridden, incontinent, and requires extensive help with personal care. Level VI, Dead (Score 6): The patient has died [40, 41].

For data collection, the mRS is used to categorize patients' functional outcomes at various points in their

recovery or follow-up. This assessment helps in evaluating the impact of interventions, tracking recovery progress, and determining the overall effectiveness of treatment strategies. The scale provides a standardized way to measure disability and is an important component of both clinical and research assessments [42].

First, the TyG (Triglyceride-Glucose) Index values for all patients were calculated. Patients with ischemic stroke who had elevated TyG Index values were then compared to those with normal TyG Index values to assess differences in clinical outcomes, specifically focusing on stroke recurrence and all-cause mortality. The TyG Index was determined using the formula: ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL) / 2]. The necessary data for this calculation were obtained from patient case reports, laboratory test results, and the completed data collection forms.

### Statistical analysis

The data entry and analysis were conducted using SPSS version 25.0. Categorical variables were reported as counts and percentages (%), while continuous variables were presented as means and standard deviations (SD). To compare clinical features between groups, the Student's t-test was used. Pearson correlation analysis was applied to explore the relationship between the TyG (Triglyceride-Glucose) Index and various clinical variables and outcomes. Univariate Cox regression analysis was utilized to examine the association between TyG Index values and clinical outcomes. Additionally, a scatter plot was created to visualize the relationship between the TyG Index and clinical outcomes. Kaplan–Meier survival analysis was performed to compare survival rates between groups with high and low TyG Index risk.

## Results

A total of 95 patients were included in this study. The majority (63.2%) were males and females accounted for 36.8%. The participants aged 59.28 ± 12.54 years.

The mean FBS in low TYG INDEX was found to be 107.0 ± 19.3 mg/dL as compared to 186.3 ± 76.6 (*P*-value < 0.001). Significantly higher percentages of patients with high TYG INDEX had diabetes, hypertension, higher FBS, higher TG, higher total cholesterol or more commonly smoke tobacco or take alcohol compared to patients with low TYG INDEX (Table 1).

Atorvastatin (96.8%), Aspirin (91.6%), and Pantoprazole (49.5%) were the most commonly described discharge medications. While the prescription rate of atorvastatin, and aspirin were comparable between the ischemic patients with risk or with no risk TYG INDEX groups, telmisartan, β-blockers and clopidogrel were more commonly prescribed to those with high TYG INDEX (Table 2).

**Table 1** Patient characteristics and diagnostic parameters

| VARIABLES | All | TYG INDEX ≤ 4.808 (NO RISK) *N* = 39 | TYG INDEX > 4.808 (RISK) *N* = 56 | *P* value |
|---|---|---|---|---|
| Age | 59.3 ± 12.5 | 59.7 ± 14.9 | 58.9 ± 10.7 | 0.187 |
| Male (%) | 63.2 | 28.4 | 34.7 | **< 0.001** |
| Female (%) | 36.8 | 12.6 | 24.2 | **< 0.001** |
| Diabetes (%) | 49.5 | 11.6 | 64.3 | **< 0.001** |
| Hypertension (%) | 65.3 | 33.9 | 76.8 | **< 0.001** |
| Smoking (%) | 42.1 | 30.4 | 41.1 | **< 0.001** |
| Alcohol (%) | 37.9 | 26.8 | 37.5 | **< 0.001** |
| FBS | 153.7 ± 71.5 | 107.0 ± 19.3 | 186.3 ± 76.6 | **< 0.001** |
| LDL | 107 ± 48.3 | 94.8 ± 41.9 | 115.7 ± 50.9 | 0.808 |
| HDL | 37.25 ± 5.5 | 36.5 ± 3.8 | 37.8 ± 6.4 | 0.361 |
| TG | 157.0 ± 98.9 | 94.7 ± 27.6 | 200.4 ± 107.4 | **< 0.001** |
| Total cholesterol | 165.0 ± 51.5 | 148.1 ± 41.9 | 176.8 ± 54.4 | **< 0.001** |

*TYG INDEX* Triglyceride Glucose Index

**Table 2** Summary of patient discharge medication regimen frequencies

| VARIABLES | Total (*N* = 95) | TYG INDEX ≤ 4.8 (NO RISK, % of *N* = 39) | TYG INDEX > 4.8 (RISK, % of *N* = 56) |
|---|---|---|---|
| Aspirin | 91.6 | 89.7 | 92.9 |
| Atorvastatin | 96.8 | 94.9 | 98.2 |
| Pantoprazole | 49.5 | 64.1 | 39.3 |
| Ondansetron | 2.1 | 5.1 | 0.0 |
| Multi-vitamin | 54.7 | 48.7 | 58.9 |
| Telmisartan | 21.1 | 12.8 | 26.8 |
| Betahistine | 8.4 | 5.1 | 10.7 |
| Insulin | 28.4 | 12.8 | 39.3 |
| Metformin | 24.2 | 20.5 | 26.8 |
| CCB's | 33.7 | 15.4 | 46.4 |
| Levetriacetam | 11.6 | 20.5 | 5.4 |
| Lactulose | 25.3 | 25.6 | 25.0 |
| Clonazepam | 5.3 | 5.1 | 5.4 |
| Beta blockers | 6.3 | 2.6 | 8.9 |
| Clopidogrel | 11.6 | 7.7 | 14.3 |

### Determinants of TYG INDEX

The chi-square test showed that FBS, Triglyceride, and Total cholesterol were significantly associated with TYG INDEX whereas other variables like age, LDL, HDL (Table 3).

### The effect of triglyceride glucose index on ischemic stroke events

Univariate Cox proportional hazard model was employed to examine the relationship between the TYG Index

**Table 3** Data of correlation between patient variables and the triglyceride-glucose index

| VARIABLES | Pearson chi-square | *P* VALUE |
|---|---|---|
| Age | -0.137 | 0.187 |
| FBS | 0.719 | **< 0.001** |
| Triglyceride | 0.812 | **< 0.001** |
| LDL | 0.025 | 0.808 |
| HDL | 0.095 | 0.361 |
| Total Cholesterol | 0.420 | **< 0.001** |

and stroke-related events. There was no statistically significant difference between TYG and stroke events ($p$ value = 0.192) (Table 4).

### The correlation of triglyceride-glucose index and modified ranking scale (mrs)

In both groups of patients, risk and no risk TYG INDEX values, the mRS score showed variable and unpredictable relationship with the TYG INDEX (Table 5).

### TYG INDEX and ischemic stroke clinical outcome events

The percentage of patients with any event (46.2% vs 37.5%) or death (8.4% vs 6.3%) from ischemic stroke was comparable between the no risk (TYG INDEX ≤ 4.8), and risk (TYG INDEX > 4.8), and no statistically significant difference was observed (Table 6). A negative deviation was observed showing TYG INDEX and clinical outcomes in ischemic stroke patients though it was not statistically significant (Fig. 1).

Kaplan–Meier survival analysis for two groups of high and low TYG INDEX showed no statistical significance in the difference of ischemic stroke events. The survival and hazard curves of patients with low and high TGY INDEX scores did not differ significantly (Fig. 2(a) and (b)).

**Table 4** The association between TYG index and clinical outcomes

| VARIABLES | HR | 95% CI | *P*-VALUE |
|---|---|---|---|
| TyG INDEX | 1.454 | 0.829–2.552 | 0.192 |

## Discussion

The average age of ischemic stroke patients in this study was 59.28 ± 12.54 years, similar to the mean age of 47.1 ± 19.3 years in a study by Xiao-cong Liu et al. [2] and 64.83 ± 11.9 years in a research project [43]. The current study had a predominance of males, similar to earlier investigations.

Our research shows that 49.5% of patients have diabetes, but Mengyuan Miao et al.'s study found that 26.1% of patients had the illness. 65.3% of patients in our study had hypertension, a similar percentage to another study [43], where 65% of patients were found to have hypertension. The presence of both diabetes mellitus and hypertension in the individuals indicates that these illnesses could worsen the risk of stroke.

The study revealed high LDL, total cholesterol, triglycerides, and FBS but low HDL. These findings were comparable with what had been reported previously by Xiao-cong Liu et al. [2]. Poorly controlled blood sugar and poor lipid profile results might have contributed to the occurrence of the ischemic stroke. The mean FBS in low TYG INDEX was found to be 107.0 ± 19.3 mg/dL as compared to 186.3 ± 76.6 ($P$-value < 0.001).

Significantly, higher percentages of patients with high TYG INDEX had diabetes, hypertension, higher FBS,

**Table 5** Exploring the association between triglyceride-glucose index and mRS scores

| mRS<br>TGI | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| TGI ≤ 4.808 (41.1%) *N* = 39 | **3.2** | **4.2** | **10.5** | **7.4** | **3.2** | **6.3** | **6.3** |
| TGI > 4.808 (58.9%) *N* = 56 | **11.6** | **14.7** | **13.7** | **7.4** | **2.1** | **5.3** | **4.2** |

**Table 6** Summary of TyG index and its effect on ischemic stroke clinical outcomes

| OUTCOME<br>TYG INDEX | ANY EVENT | REOCCURENCE<br>*N* = 25(26.3%) | DEATH<br>*N* = 14(14.7%) |
|---|---|---|---|
| TYG INDEX ≤ 4.8<br>(NO RISK, *n* = 39) | 18 (46.2%) | 10(10.5%) | 8(8.4%) |
| TYG INDEX > 4.8<br>(RISK, *n* = 56) | 21 (37.5%) | 15(15.8%) | 6(6.3%) |

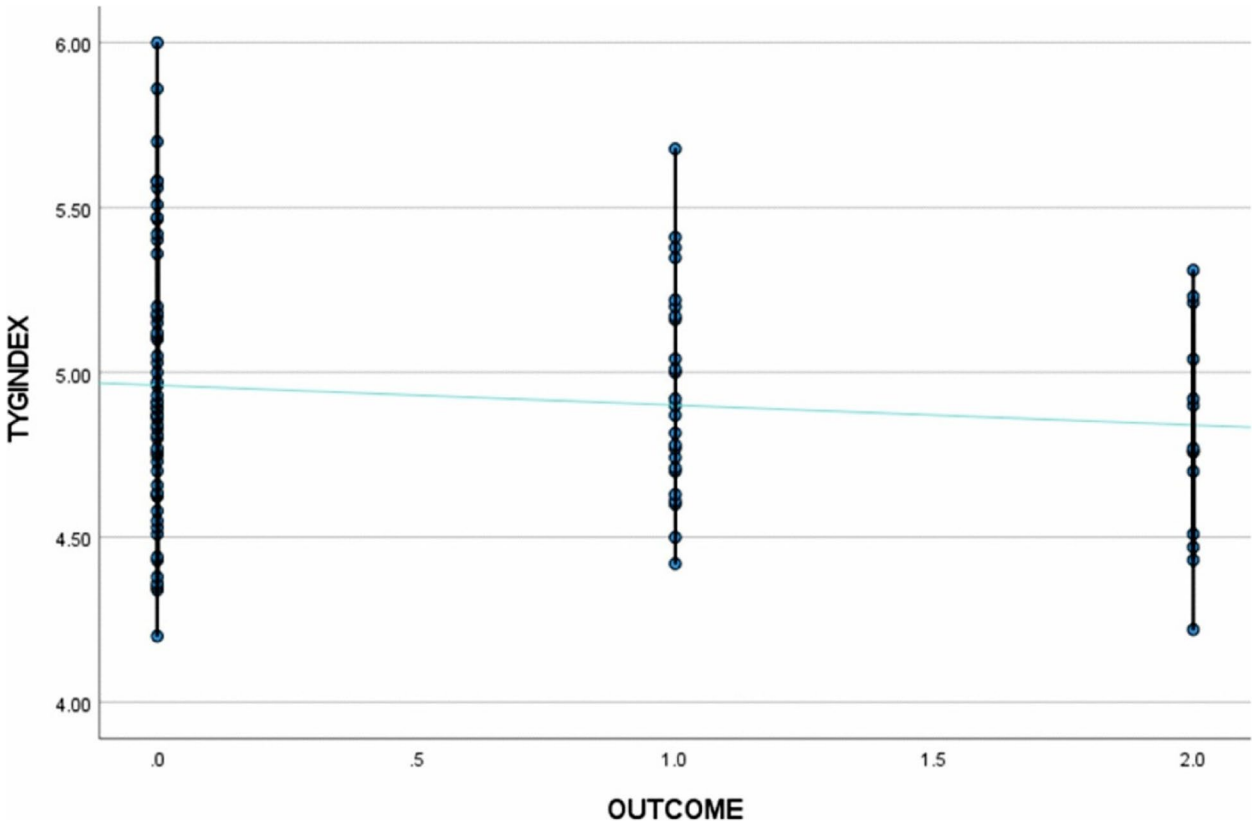



**Fig. 1** Relationship between triglyceride glucose index and outcome

higher TG, higher total cholesterol or smoking tobacco or taking alcohol compared to patients with low TYG INDEX. These associations have been reported previously. Controlling these risk factors should be used prioritized in preventing ischemic stroke in the society [44–46].

Our finding showed that Atorvastatin (96.8%), and Aspirin (91.6%) were the most commonly described discharge medications. This finding is consistent with what was reported by B.E. Ståhli et al. that showed aspirin at 99.3%, clopidogrel at 45.2%, statins at 98.2% were the most frequently prescribed drugs. However, the use of ACE inhibitors of 77.1% in the study is much higher compared to 21% in our study [47]. ACE inhibitors have been reported to significantly reduce the recurrence of ischemic stroke [48]. Our study showed that there was high adherence of the prescribers to the guidelines in prescribing the medications. While the prescription rate of atorvastatin, and aspirin were comparable between the ischemic patients with risk or with no risk TYG INDEX groups, telmisartan, β-blockers and clopidogrel were more commonly prescribed to those with high TYG INDEX. This variation of the preventive therapies might affect the subsequent clinical outcomes from ischemic stroke.

The current study showed that a TYG INDEX less than or equal to 4.808 was considered normal, and a triglyceride glucose index greater than 4.808 was considered high. In our study, 39 patients have no risk, and 56 patients have a high or abnormal triglyceride glucose index. Pearson correlation analysis showed that the triglyceride glucose index was significantly correlated with FBS (fasting blood sugar), triglycerides, and total cholesterol. Cox regression did not show any statistically significant association between the score and clinical outcomes of stroke. Kaplan–Meier analysis showed no significant difference between normal and high/abnormal TYG INDEX values. However, in the study conducted by Xiao-cong Liu et al., raised TYG INDEX was significantly related to cumulative occurrence of death (log-rank, $P < 0.001$) [2]. The findings of the current study showed no significant association between *TYG INDEX* and clinical outcomes of ischemic stroke patients. Our findings highlight the need for a holistic approach in the management of ischemic stroke instead of relying on triglyceride glucose index as a marker role.

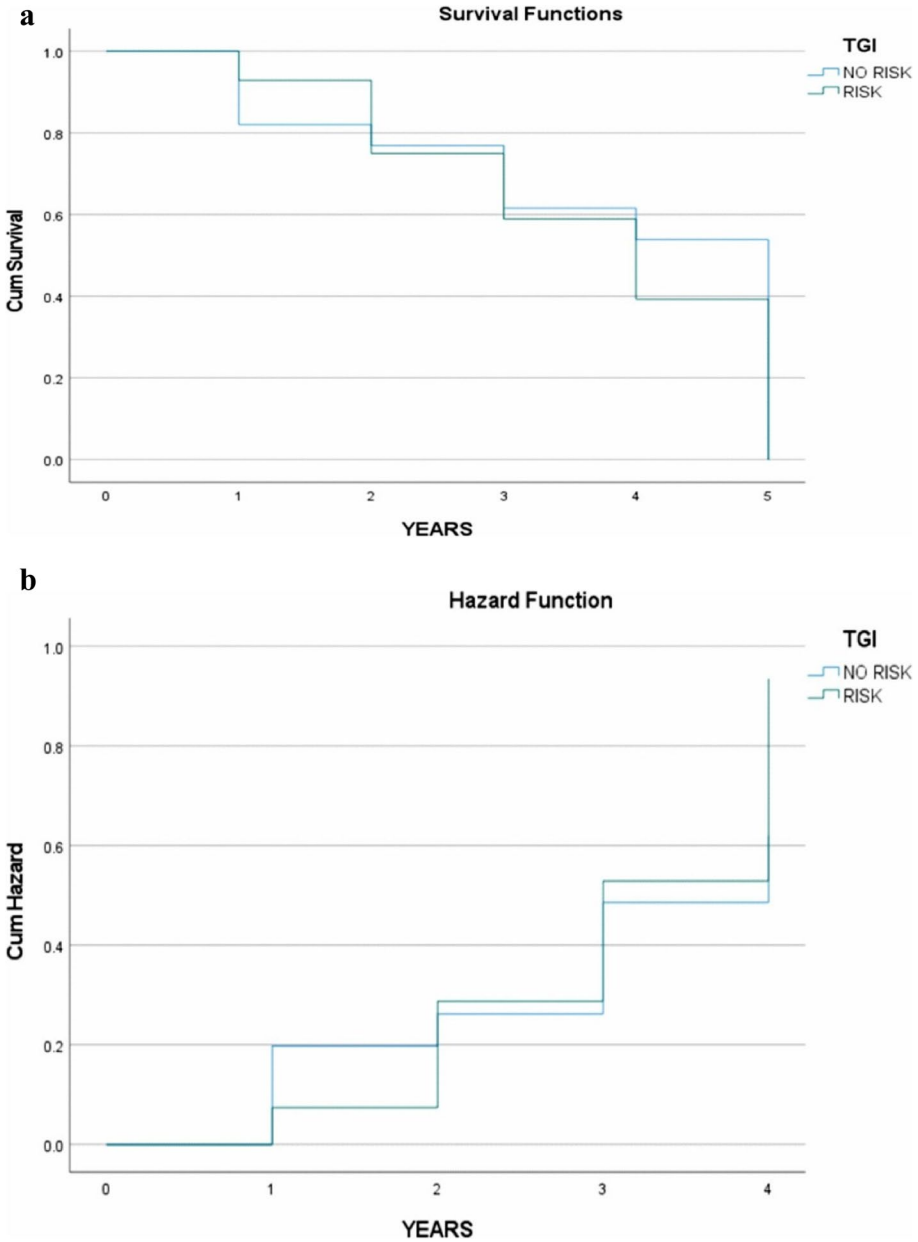



**Fig. 2** **a** The cumulative survival of patients with high TGI and those with normal TGI. **b** The cumulative hazard of ischemic stroke in patients with high TGI vs normal TGI

The percentage of patients with any event (46.2% vs 37.5%) or death (8.4% vs 6.3%) from ischemic stroke was comparable between the no risk (TYG INDEX $\leq$ 4.8), and risk (TYG INDEX > 4.8), and no statistically significant difference was observed. Similarly, in both groups of patients, risk and no risk TYG INDEX values, the mRS score showed variable and unpredictable relationship with the TYG INDEX.

Being a retrospective single-centred design of this study is a drawback. Moreover, due to the small sample size, the generalizability of the study to the larger population might be reduced. Third, because the clinical follow-up period was brief, there was a possibility of follow-up errors, which could have an impact on the accuracy of the results. It will take more extensive research to evaluate the implications of these limitations. Thus, we recommend a larger multicentred study to confirm the current findings of no association

between TYG INDEX and clinical outcomes in stroke patients.

## Conclusion

This retrospective study aimed to explore the association between the Triglyceride-Glucose (TyG) Index and clinical outcomes in patients with ischemic stroke. Our findings indicate that there is no significant correlation between the TyG Index and clinical outcomes. Only FBS, Triglyceride, and Total cholesterol were significantly associated with TYG INDEX. However, the TyG Index had been associated with cardiovascular outcomes in previous studies, suggesting its potential relevance in broader cardiovascular contexts. Further studies with larger sample sizes and diverse populations are needed to confirm these findings and fully understand the role of the TyG Index in stroke and cardiovascular health.

### Abbreviations

| | |
|---|---|
| ACS | Acute Coronary Syndrome |
| HDL | High Density Lipoprotein |
| LDL | Low Density Lipoprotein |
| FBS | Fasting Blood Sugar |
| HOMA | Homeostatic Model Assessment for Insulin Resistance |
| IS | Ischemic Stroke |
| IR | Insulin Resistance |
| TYG INDEX | Triglyceride Glucose Index |

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### Authors' contributions

S.P.N.B., P.B.B.R., K.D.D.K., S.K., K.S., D.S., J.V., S.P.R. and T.M.Y., Y.S.H. contributed to the conceptualization, methodology, data monitoring, data analysis, original draft preparation, draft review, and editing. K.D.D.K., S.K., K.S., and D.S. contributed to methodology, data acquisition, data monitoring, data analysis, original draft preparation, draft review, and editing. S.P.N.B., P.B.B.R. and T.M.Y. contributed to the methodology, data monitoring, draft review, and editing. J.V., S.P.R. and Y.S.H. contributed to data acquisition, draft review, and editing. All authors have read and agreed to the published version of the manuscript.

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### Availability of data and materials

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

### Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

The study was approved by the Institutional Research Cell (IRC), followed by IEC – Dr. PSIMS and RF bearing approval number UG/516/19. All the procedures were followed in accordance with the relevant guidelines (e.g. the Declaration of Helsinki) at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences, and Research Foundation, Vijayawada, Andhra Pradesh, India, i.e., All patients gave an informed consent before their recruitment in to the study.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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