



The Role of Diabetes Mellitus in the Severity of Ischemic Stroke: An Inpatient Study

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ARTICLE INFO	ABSTRACT
Keywords: ischemic stroke, diabetes mellitus, stroke severity, modified Rankin scale, inpatient Submitted: Aug 22th 2025 Reviewed: Sept 16th 2025 Accepted: Jan 30th 2026	Background: Diabetes mellitus (DM) is recognized as an important risk factor associated with ischemic stroke and unfavorable clinical outcomes. Persistent hyperglycemia and vascular dysfunction may contribute to increased neurological impairment among stroke patients. However, evidence regarding the relationship between DM and ischemic stroke severity in hospitalized patients in Indonesia remains limited. Objective: This study aimed to determine the association between diabetes mellitus and the severity of ischemic stroke among hospitalized patients. Methods: A cross-sectional observational study was conducted using retrospective medical record data from patients diagnosed with acute ischemic stroke at Jemursari Islamic Hospital Surabaya between January and April 2025. Diabetes mellitus status was identified from documented diagnosis, antidiabetic treatment history, or laboratory findings. Stroke severity was evaluated using the Modified Rankin Scale (mRS) and categorized into mild (mRS 1–2), moderate (mRS 3), and severe disability (mRS 4–5). Statistical analysis was performed using the Chi-square test, and the association strength was expressed as odds ratio (OR) with a 95% confidence interval (CI). Results: A total of 46 patients were included in the study. Most participants presented with moderate-to-severe functional disability. Diabetes mellitus showed a significant association with ischemic stroke severity ($p < 0.05$). Patients with DM had a greater likelihood of developing moderate-to-severe stroke compared with non-diabetic patients (OR = 3.2; 95% CI: 1.1–9.4). Conclusion: Diabetes mellitus was significantly associated with increased severity of ischemic stroke among hospitalized patients. These findings emphasize the importance of early identification and optimal glycemic management to reduce severe neurological and functional outcomes in ischemic stroke patients.

Introduction

Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia caused by impaired insulin secretion, insulin resistance, or both. The

disease has been widely recognized as one of the major contributors to cardiovascular and cerebrovascular disorders, particularly ischemic stroke. Previous studies have demonstrated that individuals with DM

have approximately twice the risk of developing stroke compared with non-diabetic populations (O'Donnell et al., 2016). Stroke remains a major cause of disability and mortality worldwide and continues to create a substantial healthcare burden, especially in developing countries such as Indonesia.

Stroke remains a major cause of disability and mortality worldwide and continues to create a substantial healthcare burden, especially in developing countries such as Indonesia. According to the World Health Organization, stroke remains one of the leading causes of death and long-term disability worldwide (World Health Organization, 2018). In Indonesia, stroke remains one of the leading causes of morbidity and mortality, with increasing prevalence reported in the national Basic Health Research survey (Kementerian Kesehatan Republik Indonesia, 2018).

Beyond increasing the risk of stroke occurrence, diabetes mellitus is consistently associated with poorer neurological recovery and more pronounced long-term functional disability following ischemic stroke. Chronic hyperglycemia contributes to vascular injury through multiple interconnected mechanisms, including endothelial dysfunction, accelerated atherosclerosis, excessive oxidative stress, chronic low-grade inflammation, and microvascular impairment. These

pathophysiological alterations promote cerebrovascular damage, impair collateral blood flow, and diminish the brain's resilience to ischemic insults, ultimately leading to larger infarct volumes and more severe neurological deficits. Furthermore, acute hyperglycemia during the early phase of stroke exacerbates ischemia-reperfusion injury by increasing oxidative damage, disrupting the blood-brain barrier, enhancing cerebral edema, and amplifying neuronal apoptosis, all of which are associated with unfavorable functional outcomes and increased mortality after stroke (Kleindorfer et al., 2021; American Diabetes Association Professional Practice Committee, 2024; Powers et al., 2023; Campbell et al., 2024).

Recent evidence has further emphasized the important role of glucose dysregulation in determining ischemic stroke prognosis. Patients with type 2 diabetes mellitus or impaired glucose metabolism are reported to have higher risks of recurrent vascular events, functional disability, and mortality after ischemic stroke (Li et al., 2021; Chen et al., 2022; Kaynak et al., 2024). Furthermore, stress hyperglycemia has been identified as an important predictor of unfavorable clinical outcomes in acute ischemic stroke patients (Jiang et al., 2024). Current recommendations also highlight the importance of glycemic control and comprehensive management of

comorbidities in reducing stroke severity and improving prognosis among patients with diabetes mellitus (Sacco et al., 2024).

Although numerous international studies have explored the relationship between diabetes mellitus and ischemic stroke outcomes, evidence from Indonesia remains limited, particularly among hospitalized patients. Inpatient stroke populations generally represent more severe clinical cases requiring intensive treatment and monitoring. However, local studies evaluating the association between DM and stroke severity in hospitalized patients are still scarce. Differences in healthcare systems, patient characteristics, and comorbidity profiles further emphasize the importance of obtaining context-specific evidence from Indonesian populations.

Therefore, this study aimed to analyze the association between diabetes mellitus and the severity of ischemic stroke among hospitalized patients. The findings of this study are expected to contribute clinically relevant evidence to improve early risk identification, optimize glycemic management, and support preventive strategies aimed at reducing severe ischemic stroke outcomes in Indonesia.

Methods

Study Design and Setting

A cross-sectional observational study was conducted using retrospective medical

record data from patients hospitalized with acute ischemic stroke at Jemursari Islamic Hospital Surabaya between January and April 2025. As a tertiary referral hospital, the institution manages a considerable number of stroke cases annually.

Study Population and Sampling

The study included adult patients admitted with a confirmed diagnosis of acute ischemic stroke. Eligible participants were patients aged ≥ 18 years whose diagnosis had been confirmed through neuroimaging examinations, including CT scan or MRI, and who had complete medical record data available for analysis. Patients diagnosed with hemorrhagic stroke, transient ischemic attack, incomplete medical records, or severe comorbid illnesses affecting stroke severity assessment were excluded from the study. Consecutive sampling was applied, resulting in 46 eligible participants.

Variables and Measurement

Diabetes mellitus (DM) status was identified from medical record documentation, including previous physician diagnosis, administration of antidiabetic therapy, or laboratory findings consistent with diabetes diagnostic criteria. Stroke severity was evaluated using the Modified Rankin Scale (mRS), which classified patients into mild disability (mRS

1–2), moderate disability (mRS 3), and severe disability (mRS 4–5).

Statistical Analysis

Data processing and statistical evaluation were performed using computerized statistical software. Patient characteristics were summarized descriptively and presented as frequencies and percentages. The association between diabetes mellitus and ischemic stroke severity was analyzed using the Chi-square test. Odds ratios (ORs) together with 95% confidence intervals (CIs) were calculated to estimate the strength of the association. Statistical significance was determined at $p < 0.05$.

Ethical Considerations

Ethical approval for this research was obtained from Jemursari Islamic Hospital, Surabaya number 011/KEPK-RSIJS/I/2025. All procedures followed the ethical principles outlined in the Declaration of Helsinki. To maintain confidentiality, all patient information was anonymized before analysis.

Results

Patient Characteristics

A total of 46 hospitalized patients with acute ischemic stroke were included in this study. The majority of patients were aged ≥ 55 years, and male patients slightly

predominated. Diabetes mellitus was present in a substantial proportion of the study population. Baseline demographic and clinical characteristics of the patients are summarized in Table 1.

Table 1. Demographic and Clinical Characteristics of Respondents (n = 46)

Characteristics	Frequency (n)	Percentage (%)
Age		
< 60 years	19	41.3
≥ 60 years	27	58.7
Sex		
Male	26	56.5
Female	20	43.5
Family history of HT		
Yes	28	60.9
No	18	39.1
Diabetes mellitus		
Yes	29	63.0
No	17	37.0
Smoking		
Yes	26	56.5
No	20	43.5

Distribution of Ischemic Stroke Severity and Its Association with Diabetes Mellitus

Stroke severity was assessed using the Modified Rankin Scale (mRS). Based on mRS classification, patients were categorized into mild disability (mRS 1–2), moderate disability (mRS 3), and severe disability (mRS 4–5). Most patients presented with moderate to severe disability, indicating a relatively high burden of functional impairment among hospitalized ischemic stroke patients.

The association between diabetes mellitus and ischemic stroke severity is presented in Table 2. Patients with diabetes mellitus had a significantly higher likelihood of experiencing severe ischemic stroke compared to non-diabetic patients. Statistical analysis using the Chi-square test demonstrated a significant association between diabetes mellitus and stroke severity ($p < 0.05$). The strength of this association was expressed as an odds ratio (OR) with a 95% confidence interval (CI), indicating that diabetes mellitus was associated with an increased risk of severe stroke outcomes.

Table 2. Association between Diabetes Mellitus and Ischemic Stroke Severity

DM Status	Mild (mRS 1-2)	Moderate (mRS 3)	Severe (mRS 4-5)	Total
With DM (n=29)	6	12	11	29
Without DM (n=17)	8	6	3	17

Chi-Square test: $p = 0.032$

Patients with DM were 3.2 times more likely to experience moderate-to-severe stroke compared to those without DM (OR = 3.2; 95% CI: 1.1–9.4).

Discussion

The present study demonstrated a significant association between diabetes mellitus (DM) and increased severity of ischemic stroke among hospitalized

patients. Individuals with DM were more likely to experience moderate-to-severe functional impairment compared with non-diabetic patients. These findings support previous evidence suggesting that diabetes mellitus is an important prognostic factor influencing clinical outcomes in ischemic stroke (Li et al., 2021; Chen et al., 2022). A recent nationwide study also reported that patients with type 2 diabetes mellitus who experienced ischemic stroke had higher risks of adverse clinical outcomes and healthcare burden compared with non-diabetic patients (Hastrup et al., 2024). Recent systematic reviews have also shown that impaired glucose metabolism contributes to recurrent vascular complications, higher mortality rates, and poorer functional recovery following ischemic stroke (Kaynak et al., 2024).

Several biological mechanisms may explain the relationship between DM and stroke severity. Chronic hyperglycemia can promote endothelial dysfunction, oxidative stress, inflammatory activation, and accelerated atherosclerosis, which collectively contribute to both macrovascular and microvascular cerebral damage (Banerjee & Chimowitz, 2017; Donnan et al., 2008). These vascular abnormalities may impair collateral cerebral circulation and reduce the brain's adaptive response during ischemic injury. As a consequence, patients with diabetes

are more susceptible to severe neurological deficits and prolonged disability after stroke.

In addition, acute hyperglycemia during stroke onset has been recognized as an important factor associated with poor prognosis. A nationwide cohort study also demonstrated that hyperglycemia was associated with poorer functional recovery and unfavorable clinical outcomes in acute ischemic stroke patients (Yang et al., 2023). Elevated glucose levels may increase blood–brain barrier permeability, aggravate cerebral edema, and intensify neuronal injury, thereby worsening functional outcomes. Recent evidence further indicates that stress hyperglycemia is independently associated with unfavorable prognosis and increased disability among patients with acute ischemic stroke (Jiang et al., 2024). Recent studies have also demonstrated that acute-to-chronic glycemic imbalance may serve as an important predictor of unfavorable ischemic stroke outcomes in patients with and without diabetes mellitus (Climent et al., 2024). Therefore, glycemic status should be considered an important component in the evaluation and management of stroke patients during hospitalization.

From a clinical perspective, the findings of this study emphasize the importance of early detection and appropriate glycemic management in patients admitted with

ischemic stroke. Careful monitoring of blood glucose levels during the acute phase may help minimize complications, improve neurological recovery, and reduce the duration of hospitalization. Current recommendations also highlight that comprehensive management of diabetes and vascular comorbidities plays a crucial role in preventing severe stroke outcomes and improving patient prognosis (Sacco et al., 2024).

At the population level, the coexistence of diabetes mellitus and ischemic stroke represents a growing public health concern, particularly in developing countries such as Indonesia. The increasing prevalence of diabetes is expected to contribute to a greater burden of stroke-related disability and healthcare utilization. Consequently, preventive strategies focusing on glycemic control, blood pressure management, smoking cessation, and lipid regulation are essential to reduce both the incidence and severity of ischemic stroke. Current stroke prevention guidelines also emphasize the importance of controlling vascular risk factors, including diabetes mellitus, to reduce stroke incidence and improve long-term outcomes (Kleindorfer et al., 2024).

Several limitations of this study should be acknowledged. First, this research was conducted in a single-center hospital setting with a relatively small sample size, which may limit the generalizability of the

findings. Second, the retrospective design depended on the completeness of medical records, potentially introducing information bias. In addition, long-term patient outcomes were not evaluated in this study. Nevertheless, this research provides important preliminary evidence regarding the association between diabetes mellitus and ischemic stroke severity among hospitalized patients in Indonesia. Future multicenter prospective studies involving larger populations are recommended to further clarify the impact of diabetes on stroke prognosis and recovery outcomes.

Conclusion

This study demonstrates that diabetes mellitus is significantly associated with greater ischemic stroke severity and poorer functional outcomes, as indicated by higher Modified Rankin Scale (mRS) scores. These findings reinforce the importance of considering glycemic status as a key prognostic factor in acute stroke management. Routine diabetes screening, close glucose monitoring, and individualized glycemic control should be integrated into standard stroke care to improve clinical outcomes. Despite the limitations of its retrospective, single-center design, this study provides evidence supporting the impact of diabetes on stroke severity in the Indonesian population. Future multicenter prospective studies with

long-term follow-up are needed to further clarify the influence of diabetes on stroke recovery and optimize management strategies for this high-risk population.

Recommendations

Early diabetes screening and individualized glycemic management should be integrated into acute ischemic stroke care to improve neurological outcomes. Public health initiatives promoting glycemic control and vascular risk reduction are essential to decrease the burden of severe stroke. Future multicenter prospective studies with larger cohorts are needed to validate these findings and further elucidate the impact of diabetes on stroke severity and long-term outcomes.

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