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The Relationship of Stroke Risk Factors with Patient Clinical Outcomes Based on *the Glasgow Outcome Scale* (GOS) at Royal Prima Medan Hospital in 2026

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Abstract

Stroke is a health problem that can cause neurological disorders and also affect the patient's clinical outcome. Stroke outcomes may be influenced by several underlying risk factors. This study examined the association between stroke-related risk factors and also Glasgow Outcome Scale (GOS) scores among patients treated at Royal Prima Hospital Medan in 2026. A retrospective analytical observational design was employed using medical records from 50 stroke patients. Statistical analysis involved the Chi-Square and also Fisher's Exact tests. Favorable outcomes were observed in 31 patients (62.0%), whereas 19 patients (38.0%) experienced unfavorable outcomes. Significant associations with clinical outcomes were identified for age (p=0.031), diabetes mellitus (p=0.023), hypertension (p=0.024), heart disease (p=0.043), hyperlipidemia (p=0.038), and also previous stroke history (p=0.001). In contrast, gender showed no significant association (p=0.991). Thus, age, diabetes mellitus, hypertension, heart disease, hyperlipidemia, and also prior stroke were significantly related to stroke outcomes according to the GOS, while hypertension and also gender showed no significant relationship.

INTRODUCTION

Stroke is a brain injury that results from vascular obstruction or an inadequate blood supply that causes infarction or bleeding in the parenchyma of the brain. Acute stroke can be categorized as an ischemic or hemorrhagic stroke. Ischemic stroke occurs when blood vessels become blocked so as to limit ischemic stroke results from disrupted cerebral blood flow, whereas hemorrhagic stroke develops when a blood vessel ruptures and also releases blood into the cranial cavity (Utomo, n.d.). In Indonesia, based on the 2020 Indonesian Health Profile, the number of stroke cases was recorded quite high, namely 1,789,261 Indonesians experienced or suffered from stroke (Rafiudin et al., 2024).

North Sumatra is one of the regions with Indonesia's highest stroke prevalence, based on data from 25 hospitals in North Sumatra show that the number of patients with stroke is 562 patients (Rahayu, 2023). Stroke has a variety of risk factors that can affect the incidence of stroke, namely smoking, hypertension, and also diabetes mellitus which can damage arteries throughout the body and also result in rupture of blood vessels and also blockages in arteries in the brain. An unhealthy diet, such as eating sugary foods or may also heighten stroke risk (Utama & Nainggolan, 2022).

The prognosis of stroke patients can be assessed based on clinical outcomes after the patient has received therapy, one of which is using GOS. GOS is one of the scoring systems that is often used to measure the final a TBI. This scoring was developed by Jennett and also Bond in individuals with serious brain injuries, and also in recent years GOS has also been used to measure the end outcomes of treatment of intracranial hemorrhage patients (McMillan et al., 2016; Indradmojo et al., 2020).

In an international stroke study, functional outcomes are more commonly assessed using *the* mRS, while the degree of neurological deficit is measured with *the* NIHSS (Rost et al., 2016; Broderick et al., 2017). However, this study chose GOS with several methodological considerations. First, this study is retrospective so that outcomes can only be assessed from data recorded in medical records. The determination of mRS scores requires detailed information about daily functional capacity and also dependence on assistance, which is at risk of not being fully documented in routine medical records, whereas NIHSS is a neurological deficit scale and also not a global output scale. The more common categories of GOS, including mortality, a vegetative state, severe or moderate disability, and also favorable recovery, can be determined more consistently from records of the patient's state of consciousness, communication ability, and also level of dependence at the time of discharge. Second, the study sample included both ischemic and also hemorrhagic strokes, and also GOS has been used to evaluate outcomes in patients with intracranial hemorrhage (Indradmojo et al., 2020). The authors realize that GOS is less sensitive in distinguishing degrees of mild disability than mRS, so this is listed as a limitation of the study.

In Indonesia itself, studies that assess the relationship between research examining the association between stroke risk factors and also clinical outcomes assessed using the Glasgow Outcome Scale remains limited. Hence, this study seeks to determine whether stroke risk factors are associated with clinical outcomes outcomes based on *the Glasgow Outcome Scale* at Royal Prima Medan Hospital in 2026. This research examines the association between stroke risk factors and also clinical outcomes outcomes based on *the Glasgow Outcome Scale* at Royal Prima Medan Hospital in 2026, which specifically includes the clinical profiles of individuals with stroke, the description of stroke risk factors, the clinical outcomes of stroke patients through GOS, as well as the relationship between each risk factor and also the clinical outcome. The findings are anticipated to assist healthcare professionals in assessing the association between stroke risk factors and also clinical outcomes, while also enhancing public awareness of these associations as evaluated using the GOS.

Stroke is a health problem that occurs due to abnormalities in the physiological functioning of the central nervous system due to disruption of blood flow to the brain (Rahayu, 2023). Stroke is also defined as a life-threatening medical disorder resulting from interrupted blood flow to a specific region of the brain. Stroke is divided into two groups based on its cause, namely blockages called ischemic strokes or bleeding called hemorrhagic strokes. Identification of the type of stroke is important because the treatment differs according to the type (STR KE stroke, n.d.). Stroke refers to a sudden neurological impairment affecting the brain, spinal cord, or retina, either partially or entirely, lasting at least 24 hours or resulting in death as a consequence of vascular abnormalities.

In 2021, stroke most commonly affects individuals aged 65–74 years in the world, with the most genders being male than female, while the highest mortality rate in both sexes occurs at among individuals aged 80–84 years (Qian et al., 2025).

The risk factors for stroke used in this study included age, sex, elevated blood pressure, diabetes, cardiovascular disorders, abnormal lipid levels, and also a prior history of stroke. The risk of stroke increases with age. This is related to the process of degeneration or aging that occurs naturally, including changes in blood vessels that become stiffer and also an increased

likelihood of plaque formation in blood vessels (Saifullah et al., n.d.). Gender represents a non-modifiable factor associated with stroke risk. Based on an ASNA (*ASEAN Neurologic Association*) survey of acute stroke patients in 28 hospitals in Indonesia, the incidence of stroke was found to be more in men than women, which is considered associated with additional risk factors that include more commonly found in men, such as smoking habits and also alcohol consumption.

Previous hypertension is recognized as a contributing risk factor for stroke development. Hypertension has a wide range of vascular effects and also can cause changes in the characteristics of small blood vessels throughout the body, including blood vessels in the brain (Saifullah et al., n.d.). Diabetes mellitus constitutes a significant risk factor for stroke, as persistently elevated blood glucose levels may impair vascular function and also promote atherosclerotic progression, and also disrupt the vascular system. Heart disease, especially conditions that can cause blood clots such as atrial fibrillation, are also a risk factor for stroke because originating in the heart may travel through the bloodstream to the brain, obstructing cerebral blood vessels.

Hyperlipidemia is a condition of increased fat levels in the blood, especially cholesterol, which can cause fat buildup on walls may accumulate fatty deposits, resulting in plaque formation and also atherosclerosis. Such vascular narrowing and also abnormalities may elevate stroke risk. Individuals with a previous stroke are also more susceptible to recurrence, particularly when hypertension, diabetes mellitus, or dyslipidemia remains inadequately managed. Accordingly, controlling these risk factors and also implementing secondary prevention are essential to minimize recurrent stroke risk.

Ischemic stroke accounts for approximately 80%–85% of all stroke cases, which occur as a result of obstruction or clots in one or more major arteries in the cerebral circulation (Dewi & Fitraneti, 2024). Based on timing, ischemic stroke consists of *Transient Ischaemic Attack* (TIA), which is a neurological deficit that improves in less than 30 minutes; *Reversible Ischaemic Neurological Deficit* (RIND), which is a neurological deficit that improves in less than 1 week; *Stroke In Evolution* (SIE)/*Progressing Stroke*; and also *Completed Stroke*. The most common causes of ischemic stroke are atherosclerosis thrombosis, then embolism that often occurs due to atrial fibrillation, vascular vasoconstriction, and also cerebral vasospasm after subbarchoid hemorrhage.

Hemorrhagic stroke, which accounts for about 15%–20% of all strokes, occurs when intracerebral vascular lesions rupture so that bleeding into the subcerebral space or directly into brain tissue, including due to hypertension, rupture of sacular aneurysms, rupture of arteriovenous malformations, trauma, brain tumors, and also systemic bleeding diseases including anticoagulant therapy (Hendro Putri et al., 2024).

According to Haryono (2019), Ischemic stroke results from an abrupt blockage of cerebral blood vessels, thereby disrupting normal blood circulation to the brain, and also oxygen deprivation for 60–90 seconds can reduce brain tissue function. Acute occlusion divides the brain area into a core region that quickly undergoes necrosis and also a penumbra region that still has a collateral supply so that the prognosis is better. Lack of oxygen and also glucose triggers anaerobic metabolism, glutamate release, sodium and also calcium influx, cell edema, proteolytic enzyme activation, and also mitochondrial failure that leads to cell death (Dalimunthe, 2023).

According to Powers et al. (2019), a thorough medical history is essential for the initial evaluation of stroke, particularly in identifying focal neurological manifestations, including unilateral sensory or motor impairment, facial asymmetry, dysarthria, and also aphasia, as well as the last time the patient was in normal condition. The main symptoms of stroke include hemiparesis, sensory disturbance on one side of the body, sudden visual disturbances, vertigo,

aphasia, dysarthria, dysphagia, ataxia, seizures, and also sudden loss of consciousness. Early detection of stroke can be done by recognizing the signs of "SeGeRa Ke RS", namely an asymmetrical smile, sudden Unilateral weakness, slurred speech, numbness in half of the body, sudden visual disturbances, and also severe headaches that appear suddenly (Hardini, 2024).

The Siriraj Stroke Score (SSS) is a clinical tool to distinguish ischemic and also hemorrhagic strokes using the formulas (2.5×S) + (2×M) + (2×N) + (0.1×D) – (3×A) – 12, with components S (sensorium), M (vomiting), N (headache), D (diastolic blood pressure), and also A (atheroma). Scores of >+1 lead to hemorrhagic stroke, <−1 to ischemic stroke, and also −1 to +1 are doubtful and also require further examination such as CT *scans*. Noncontrast CT *scans* are performed to distinguish the type of stroke and also must be done before therapy (Dewi & Fitraneti, 2024). In ischemic stroke, there is a *low density* area that indicates infarction (Figure 1), while in hemorrhagic stroke, hyperdensity is seen which indicates bleeding (Figure 2).

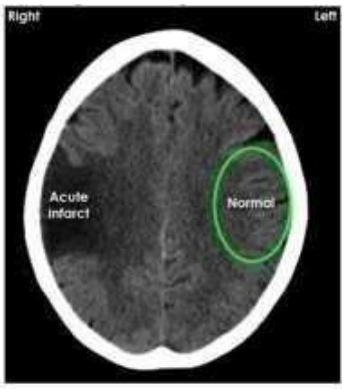


Figure 1. CT *Scan* of Ischemic Stroke (Graham et al., 2019)

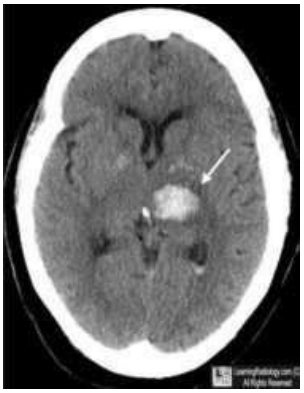


Figure 2. CT *Scan* of Hemorrhagic Stroke (Graham et al., 2019)

Other supporting examinations in stroke include electrocardiography (ECG) to assess assess cardiac electrical activity and also identify abnormalities such as atrial fibrillation or myocardial infarction, Doppler ultrasound to evaluate extra- and also intracranial blood flow and also detect stenosis or occlusion as the source of thrombus, as well as laboratory examinations that include routine blood tests and also special examinations as indicated by clinical indications (Powers et al., 2019).

According to the Ministry of Health of the Republic of Indonesia (2019), stroke management is divided according to its etiology, namely ischemic stroke management (thrombolysis according to indications and also antiplatelets) and also hemorrhagic stroke management which includes coagulopathy correction, blood pressure correction, arterial hypertension emergency management, and also surgical procedures according to the location, hematoma size, and also neurological the patient's clinical status.

Stroke-related complications may involve aspiration pneumonia, seizures, depression, cerebral edema with elevated intracranial pressure, along with deep vein thrombosis and also pulmonary embolism. Disabilities such as paralysis can lead to limitations in carrying out daily activities so that patients experience dependence on family members or *caregivers* (Listari et al., 2020). Disabilities that persist in the long term can increase the cost of treatment and also rehabilitation (Persson et al., 2012). Most (78.9%) poststroke patients have a low quality of life due to their disability (Valentina et al., 2015), and also these physical limitations lead to dependence on the family (Yualita et al., 2019).

The GOS category consists of five values, and also the GOS value can be classified into VS–SD and also MD–GR with the aim of creating a broader output category (Indradmojo et al., 2020), as presented in Table 1.

Table 1. Glasgow Outcome Scale *(GOS)* Categories

Value	Categories	External Groups
1	Death (*Death*/D)	*Unfavourable outcome*
2	Persistent Vegetative *State (*VS)	*Unfavourable outcome*
3	Severe *Disability* (SD)	*Unfavourable outcome*
4	Moderate *Disability* (MD)	*Favourable outcome*
5	Good Recovery (GR)	*Favourable outcome*

Sources: Indradmojo et al. (2020); OpenMed (2022).

The prognosis of head injury varies from mild to severe, and also can even lead to death, with a mortality rate of around 6.17–11.22% and also in severe head injuries reaching 25–37%. Prognosis assessment can use GOS which groups outcomes into *favorable* and also *unfavorable*, and also can be predicted within the first 7 days of treatment. Outcomes are influenced by demographic, clinical, and also CT *scan findings* such as hematoma, *brain swelling*, and also *midline shift*, including the time of surgery (Sutawan et al., 2021). The GOS assessment is carried out from the beginning of treatment until the patient discharges by considering the level of awareness, speech ability, and also motor function, thereby aiding clinical decision-making and also providing prognosis information to the patient's family (Berlianty et al., 2022).

The theoretical framework of this study illustrates that stroke risk factors affect the pathophysiological process of stroke in the form of blockage or bleeding of brain blood vessels, which further determines the clinical outcomes of stroke patients assessed with GOS, as presented in Table 2.

Table 2. Research Theory Framework

Risk Factors for Stroke	Pathophysiological Process of Stroke	Clinical Externalities (GOS)
Age Gender Hypertension Diabetes mellitus Heart disease Hyperlipidemia Previous stroke history	Blockage or bleeding of the blood vessels of the brain	*Death* *Vegetative State* *Severe Disability* *Moderate Disability* *Good Recovery*

The hypothesis of this study is that there is a relationship between stroke risk factors and also patient clinical outcomes based on *the Glasgow Outcome Scale* (GOS), assuming based on previous research that there is a relationship between risk factors for other diseases and also clinical outcomes based on the GOS assessment.

RESEARCH METHODS

Research Type and also Design

This quantitative study employed an analytical observational approach with a retrospective design to examine the association between stroke risk factors and also patient clinical outcomes, assessed using GOS, at Royal Prima Medan Hospital. Existing medical records of patients diagnosed with stroke served as the primary data source for the retrospective analysis. No intervention was administered, as the researcher collected and also documented relevant medical record information according to the predefined study variables. The

independent variables comprised age, sex, hypertension, diabetes mellitus, heart disease, hyperlipidemia, and also a history of previous stroke, whereas the dependent variable was the patient's clinical outcome based on the GOS.

Research Location and also Time

The outcomes as carried out at Royal Prima Hospital Medan, as the institution supports various facilities and also needs related to research. The research was conducted from April 2026 to August 2026.

Population and also Research Sample

The research population comprises all patients diagnosed with stroke at Royal Prima Medan Hospital between April and also August 2026. The sample consists of medical records from stroke patients during the specified period that satisfy the predetermined inclusion and also exclusion criteria. Eligible records include those documenting adult and also elderly patients diagnosed with stroke at Royal Prima Medan Hospital from April to August 2026, provided that complete data are available for the variables examined, namely age, diabetes mellitus, hypertension, cardiac disease, hyperlipidemia, history of previous stroke, and also GOS. Exclusion criteria include medical record data that is incomplete or does not contain the necessary information, patients over 85 years old, and also medical record data that cannot be used to determine clinical outcomes based on GOS.

Based on these criteria, as many as 50 medical record data were obtained that met the research criteria. All data were used as samples with *total sampling* techniques. The sample included all types of stroke, both ischemic and also hemorrhagic stroke, which were analyzed as a group. Separate analysis based on stroke subtypes was not carried out due to the limited number of samples (N = 50), so the division into subgroups would result in a small number of subjects per cell to be analyzed with the Chi-Square test.

Research Instruments

The instruments used were medical records and also GOS. Medical records were used as a data source to obtain information about patient identity, diagnosis, disease history, and also other data according to the study variables, while GOS was used the clinical outcomes of stroke patients. The reasons for choosing GOS over mRS have been described in the introduction (McMillan et al., 2016; Broderick et al., 2017; Indradmojo et al., 2020).

The GOS assessment was conducted at a single point in time, i.e. when the patient *discharged*, based on the clinical conditions recorded on the patient's medical resume and also recent development records. This study did not use outpatient *follow-up* data, including evaluation at the 3rd month after onset which is generally recommended in stroke outcomes studies (Broderick et al., 2017), so the outcomes assessed were short-term clinical outcomes when the patient discharged.

Data Collection Procedure

The research was carried out after obtaining ethical approval from the Faculty of Medicine, Dentistry, and also Health Sciences, Universitas Prima Indonesia and also a research permit from RSU Royal Prima Medan. Data collection was carried out retrospectively by tracing the medical records of stroke patients in the period April to August 2026. Patients do not need to be present in person because the data used is secondary data. The data collected incorporated age, gender, hypertension, diabetes, and also cardiovascular disease, hyperlipidemia, previous stroke history, and also clinical outcomes based on GOS. Data that met the criteria were then recorded and also processed for analysis.

Data Analysis

Descriptive statistics were used to summarize the characteristics of each study variable through frequency and also percentage distributions. The association between stroke risk factors and also GOS-based clinical outcomes was then examined using the Chi-Square test.

When the Chi-Square assumptions were violated, particularly when an expected cell count below 5 occurred in a 2×2 contingency table, Fisher's Exact Test was applied instead. The strength of association was quantified using the Odds Ratio (OR) with a 95% confidence interval (CI), while the strength of the relationship is assessed using the Phi/Cramer's V coefficient<.

Operational Definition

Operational definitions are used to provide clear boundaries to the variables being studied to facilitate the process of data collection and also measurement, as presented in Table 3.

Table 3. Operational Definition

Variable	Operational Definition	Indicator	Data Collection Method	Measuring Instruments	Scale
Glasgow Outcome Scale (GOS)	An assessment scale that describes the patient's clinical outcomes or recovery rate after a stroke	Death *Vegetative state* *Severe disability* *Moderate disability* *Good recovery*	Assessment based on the patient's condition when discharged through medical records	Observation sheets and also medical records	Ordinal
Risk factors for stroke	Conditions, characteristics, or habits that can increase a person's chances of having a stroke	Age Gender Hypertension Diabetes mellitus Heart disease Hyperlipidemia Previous stroke history	Data collection based on patient medical records	Observation sheets and also medical records	Nominal

RESULTS

The study took place at Royal Prima Medan Hospital, one of the largest private hospitals and also referral centers for the people of Medan City and also North Sumatra, with data collected during April-August 2026 on 50 medical records of stroke patients. Clinical outcomes were determined by assessing GOS scores based on the patient's clinical condition when returning from hospitalization as recorded in medical records.

Univariate Analysis

The characteristics of stroke patients based on gender, age, and also risk factors are presented in Table 4. The age of the respondents was grouped into adults (≤59 years) and also the elderly (≥60 years), while other risk factor variables were categorized into yes and also no.

Table 4. Frequency Distribution of Characteristics and also Risk Factors of Stroke Patients at Royal Prima Hospital Medan in 2026

Variable	Categories	Frequency (f)	Percentage (%)
Gender	Male	21	42,0
	Women	29	58,0

Variable	Categories	Frequency (f)	Percentage (%)
Age	Adult (≤59 years)	14	28,0
	Senior (≥60 years old)	36	72,0
Diabetes mellitus	Yes	19	38,0
	No	31	62,0
Hypertension	Yes	24	48,0
	No	26	52,0
Heart disease	Yes	20	40,0
	No	30	60,0
Hyperlipidemia	Yes	12	24,0
	No	38	76,0
Previous stroke history	Yes	19	38,0
	No	31	62,0

Description: N = 50 for each variable.

Based on Table 4, there were more female respondents, namely 29 respondents (58.0%), compared to 21 male respondents (42.0%). The majority of respondents belonged to the older adult age category (≥60 years), namely 36 respondents (72.0%), while the adult group (≤59 years) was 14 respondents (28.0%). A total of 31 respondents (62.0%) did not have diabetes mellitus, while 19 respondents (38.0%) had diabetes mellitus. Respondents who did not have hypertension were slightly more, namely 26 respondents (52.0%), compared to those who had hypertension as many as 24 respondents (48.0%).

A total of 30 respondents (60.0%) did not have heart disease, while 20 respondents (40.0%) had heart disease. A total of 38 respondents (76.0%) did not experience hyperlipidemia, while 12 respondents (24.0%) had hyperlipidemia. In addition, 31 respondents (62.0%) had no previous history of stroke, while 19 respondents (38.0%) had a history of previous stroke. Thus, the majority of stroke patients in this study were women and also the elderly.

Patients' clinical outcomes were assessed using GOS with a value range of 1 to 5, death, vegetative state, severe disability, moderate disability, and also good recovery. The GOS distribution values is presented in Table 5.

Table 5. Frequency Distribution of *Glasgow Outcome Scale* (GOS) Scores in Stroke Patients at Royal Prima Medan Hospital in 2026

GOS Value	Frequency (f)	Percentage (%)
Death	5	10,0
Vegetative state	2	4,0
Severe disability	12	24,0
Moderate disability	10	20,0
Good recovery	21	42,0
Total	50	100,0

As presented in Table 5, the most common GOS value found was *good recovery*, namely 21 respondents (42.0%). Furthermore, 12 respondents (24.0%) had a GOS *value of severe disability*, 10 respondents (20.0%) *moderate disability*, 5 respondents (10.0%) death category comprised the reported cases, while 2 respondents (4.0%) were classified as being in a vegetative state. Subsequently, GOS scores were grouped into unfavourable outcomes for scores of 1–3 and also favourable outcomes for scores of 4–5 as presented in Table 6.

Table 6. GOS Category Frequency Distribution in Stroke Patients at Royal Prima Medan Hospital in 2026

GOS Categories	Frequency (f)	Percentage (%)
Unfavourable outcome (GOS 1–3)	19	38,0
Favorable outcome (GOS 4–5)	31	62,0
Total	50	100,0

Based on Table 6, as many as 31 respondents (62.0%) were in the *category of favorable outcome*, while 19 respondents (38.0%) were in the category *of unfavorable outcome*. Thus, *favorable outcomes* are more common clinical outcomes found in study respondents.

Bivariate Analysis

The relationship between each risk factor and also the GOS category was evaluated using the Chi-Square test, with Fisher's Exact Test applied when any cell had an expected count below 5. The cross-tabulated findings along with the statistical test values, relationship strength (Cramer's V), and also *Odds Ratio* are presented in Table 7 to Table 13.

Age Relationship with GOS Category

Table 7. Age Relationship with GOS Category in Stroke Patients at Royal Prima Hospital Medan in 2026

Age	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Adult (≤59 years)	2 (14,3)	12 (85,7)	14 (100,0)	0,031	0,186 (0,036–0,954)
Senior (≥60 years old)	17 (47,2)	19 (52,8)	36 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Remarks: Pearson Chi-Square = 4.641; DF = 1; Cramer's V = 0.305 (Phi = −0.305). OR compares the adult group to the elderly.

The Chi-Square analysis yielded p=0.031 (p<0.05), indicating a statistically significant association between age and also GOS classification. All expected cell frequencies exceeded 5, with the lowest value recorded at 5.32, confirming that the Pearson Chi-Square assumptions were satisfied. Cramer's V value of 0.305 indicated relatively low relationship strength, while a negative Phi value indicated the direction of the relationship based on the coding of variables in SPSS. Odds *Ratio* value of 0.186 indicated that the adult group had lower *unfavorable outcome odds* than the elderly group.

Relationship between Diabetes Mellitus and also GOS Categories

Table 8. The Relationship between Diabetes Mellitus and also GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Diabetes Mellitus	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Yes	11 (57,9)	8 (42,1)	19 (100,0)	0,023	

Diabetes Mellitus	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
No	8 (25,8)	23 (74,2)	31 (100,0)		3,953 (1,173–13,325)
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 5.148; DF = 1; Cramer's V = 0.321.

The Chi-Square analysis yielded p=0.023 (p<0.05), indicating a statistically significant relationship between diabetes mellitus and also the GOS category. All expected cell frequencies exceeded 5, with the lowest expected count being 7.22. Cramer's V value of 0.321 indicates a relatively low strength of relationship. An *Odds Ratio* value of 3.953 indicates that respondents with diabetes mellitus had *unfavorable outcomes* odds of about 3.953 times compared to respondents without diabetes mellitus.

The Relationship of Hypertension with GOS Categories

Table 9. The Relationship of Hypertension with GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Hypertension	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Yes	13 (54,2)	11 (45,8)	24 (100,0)	0,024	3,939 (1,168–13,281)
No	6 (23,1)	20 (76,9)	26 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 5,120; DF = 1; Cramer's V = 0.320.

Pearson’s Chi-Square analysis yielded p = 0.024 (p < 0.05), indicating a statistically significant association between hypertension and also GOS classification. As all expected cell frequencies exceeded 5, with the lowest expected count being 9.12, the assumptions for applying Pearson’s Chi-Square test were satisfied. The Cramer's V value of 0.320 with a significance of 0.024 shows a statistically significant relationship. The *Odds Ratio value* of 3,939 with a 95% CI of 1,168–13,281 included the number 1, so it was in line with Chi-Square analysis revealed.

The Relationship of Heart Disease with GOS Categories

Table 10. The Relationship between Heart Disease and also GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Heart Disease	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Yes	11 (55,0)	9 (45,0)	20 (100,0)	0,043	3,361 (1,016–11,117)
No	8 (26,7)	22 (73,3)	30 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 4.089; DF = 1; Cramer's V = 0.286.

Chi-Square analysis yielded p=0.043 (p<0.05), indicating a significant association between heart disease and also GOS classification. All cells had expected counts above 5, with the lowest expected value recorded at 7.60. Cramer's V value of 0.286 indicates a relatively low strength of the relationship. An *Odds Ratio* value of 3.361 indicates that respondents with heart disease had *unfavorable outcomes* odds of about 3.361 times compared to respondents without heart disease.

Relationship of Hyperlipidemia with GOS Category

Table 11. The Relationship of Hyperlipidemia with GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Hyperlipidemia	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Yes	8 (66,7)	4 (33,3)	12 (100,0)	0.038a	4,909 (1,223–19,709)
No	11 (28,9)	27 (71,1)	38 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 5.507; df = 1; p = 0.019; Cramer's V = 0.332. [aValue] p was determined using Fisher's Exact Test (Exact Sig. 2-sided), as 1 cell (25.0%) had an expected count <5.

The Chi-Square analysis yielded p=0.019; however, one cell (25.0%) had an expected count below 5, with a minimum of 4.56. Consequently, Fisher's Exact Test was considered more appropriate, producing p=0.038 (p<0.05), which indicates a significant association between hyperlipidemia and also the GOS category. Meanwhile, Cramer's V of 0.332 suggests that the association is relatively weak. The *Odds Ratio* value of 4.909 indicates that respondents with hyperlipidemia have *unfavorable outcome odds* of around 4.909 times compared to respondents without hyperlipidemia.

Relationship of Previous Stroke History with GOS Category

Table 12. The Relationship between Previous Stroke History and also GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Previous Stroke History	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Yes	13 (68,4)	6 (31,6)	19 (100,0)	0,001	9,028 (2,423–33,632)
No	6 (19,4)	25 (80,6)	31 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 12.037; DF = 1; Cramer's V = 0.491.

The Chi-Square analysis yielded a p-value of 0.001 (p<0.05), indicating a statistically significant association between previous stroke history and also GOS classification. All expected cell frequencies exceeded 5, with the lowest expected count recorded at 7.22, confirming that the Chi-Square test assumptions were satisfied. Cramer's V value of 0.491 indicates a moderate relationship strength. The *Odds Ratio* value of 9.028 showed that respondents with a previous stroke history had *unfavorable outcome odds* of about 9.028 times compared to respondents without a previous stroke history.

Gender Relationship with GOS Category

Table 13. Gender Relationship with GOS Category in Stroke Patients at Royal Prima Medan Hospital in 2026

Gender	*Unfavourable* n (%)	*Favourable* n (%)	Total n (%)	p	GOLD (95% CI)
Male	8 (38,1)	13 (61,9)	21 (100,0)	0,991	1,007 (0,317–3,202)
Women	11 (37,9)	18 (62,1)	29 (100,0)		
Total	19 (38,0)	31 (62,0)	50 (100,0)		

Description: Pearson's Chi-Square = 0.000; DF = 1; Cramer's V = 0.002.

Chi-Square analysis yielded p=0.991 (p>0.05), indicating no statistically significant association between sex and also GOS classification. All expected cell frequencies exceeded 5, with the lowest expected value being 7.98. Cramer's V of 0.002 further reflected a negligible

association. The Odds Ratio (OR) was 1.007 (95% CI: 0.317–3.202), with the interval encompassing 1, consistent with the Chi-Square findings.

DISCUSSION

Characteristics of Research Respondents

This study involved 50 stroke patients who were treated at Royal Prima Hospital Medan in 2026. Based on gender characteristics, female respondents (58.0%) were more than male respondents (42.0%). These findings are different from several studies that found a more dominant proportion of men in reproductive age stroke cases, for example in a study of neurological clinical outcome characteristics of ischemic stroke patients who reported more men in thromboembolic stroke subtypes (Ischak et al., 2021). However, the dominance of women is in line with the age Participant characteristics, which are mostly in the elderly group (72.0%), considering that women in old age lose the protective effect of the postmenopausal hormone estrogen on the walls of blood vessels, so the age is associated with an elevated risk of cardio-cerebrovascular events.

The age distribution showed that most respondents were classified as the elderly group (≥60 years) as much as 72.0%, in line with the epidemiological characteristics of stroke as a degenerative disease whose incidence increases with age due to the cumulative atherosclerosis process and also decreased elasticity of blood vessels (Elavia et al., 2025). In addition, the comorbidity picture of respondents shows a fairly high burden of cardiovascular risk factors, namely diabetes mellitus (38.0%), hypertension (48.0%), heart disease (40.0%), hyperlipidemia (24.0%), and also previous stroke history (38.0%). This high proportion of comorbidities illustrates the multifactorial nature of stroke, where the incidence and also clinical outcomes of stroke are rarely determined by a single risk factor, but the interaction of several vascular risk factors at once (Hidayat et al., 2022).

In the assessment of clinical outcomes using GOS, most respondents (62.0%) were in the category *of favorable outcomes*, while 38.0% experienced *unfavorable outcomes*, including 10.0% of respondents who died. This more dominant *proportion of favorable outcomes* provides an initial idea that in general the treatment provided is able to produce fairly good clinical outcomes in the majority of patients, although there are still groups of patients with poor outcomes who need special attention through the identification of risk factors from the beginning of treatment.

Age Relationship with GOS Category

Age was significantly related to the GOS category (p=0.031), with the proportion *of unfavorable outcomes* in the elderly group (47.2%) much higher than in the adult group (14.3%) and also the strength of the relationship (Cramer's V 0.305) which was classified as moderate to low.

These findings are in line with the concept that age is risk factor with substantial implications for prognosis. Aging is accompanied by physiological alterations, including reduced *neuronal reserve*, diminished neuroplasticity for compensating after ischemic damage, and also changes in drug pharmacokinetics and also pharmacodynamics that may influence therapeutic efficacy (Elavia et al., 2025). Older individuals also commonly present with greater cardiovascular comorbidity and also limited physiological capacity to recover from acute cerebral injury. Nevertheless, evidence regarding the association between age and also clinical outcomes remains inconsistent; research involving specific elderly subgroups, such as those aged >75 years, has reported no significant outcome differences, potentially because very old participants constituted only a small proportion of the study samples (Unair news, 2021). Therefore, these findings highlight the relevance of recognizing vulnerable age groups when conducting initial prognostic assessments in stroke patients.

Relationship between Diabetes Mellitus and also GOS Categories

Diabetes mellitus was significantly associated with the GOS category (p=0.023), with *an unfavorable outcome odds* of about 3.9 times greater in respondents with diabetes mellitus (OR 3.953; 95% CI 1.173–13.325).

These findings are consistent with various studies that place diabetes mellitus, particularly through hyperglycemic conditions, as one of the dominant risk factors influencing the course and also clinical outcome of stroke in Indonesia (Dewi, 2024). Pathophysiologically, chronic hyperglycemia in patients with diabetes mellitus accelerates the process of atherosclerosis through oxidative stress mechanisms, endothelial dysfunction, and also increased prothrombotic status, consequently heightens the likelihood of cerebral vascular blockage and also enlarges the infarcted region. During the acute stroke phase, elevated blood glucose concentrations can further aggravate tissue damage within the ischemic penumbra through increased free radical production and also local lactic acidosis, resulting in a worse functional outcome. However, there are also studies with different populations that do not find diabetes mellitus to be an independent risk factor (Faruqi et al., 2022), which suggests that the strength of the relationship between diabetes mellitus and also stroke outcomes can be influenced by the degree of glycemic control, the duration of having diabetes, and also the presence or absence of other vascular comorbidities.

The Relationship of Hypertension with GOS Categories

The Chi-Square analysis indicated that hypertension was significantly associated with GOS category (p=0.024). The proportion of favorable outcomes in respondents with hypertension (54.2%) was higher than in respondents without hypertension (23.1%), with an Odds Ratio of 3.939; however, the 95% confidence interval (1,168–13,281) included a number of 1, so the difference was statistically significant.

Hypertension is widely recognized as the predominant risk factor for stroke, influencing both its occurrence and also clinical prognosis. Persistent elevation of blood pressure induces structural changes in cerebral vessels, promotes atherosclerosis in major arteries, and also heightens the susceptibility of small perforating vessels to rupture, thus contributing to ischemic and also hemorrhagic strokes (Rahmawati et al., 2024). Several studies report that hypertension increases the risk of ischemic stroke by up to 3.45 times and also hemorrhagic stroke by up to 3.66 times compared to individuals without hypertension (Rahmawati et al., 2024). Uncontrolled hypertension is also associated with a greater volume of infarctions and also a higher stroke recurrence rate (Puspitayanti et al., 2025). The tendency of higher favorable outcomes in respondents with hypertension in this study is in line with this concept, achieve statistical significance, which may stem from the limited sample size acknowledged in the study's limitations. Thus, blood pressure control remains important as a secondary preventive measure in stroke patients.

The Relationship of Heart Disease with GOS Categories

Heart disease was significantly associated with the GOS category (p=0.043), with an *unfavorable outcome* proportion of 55.0% in respondents with heart disease compared to 26.7% in respondents without heart disease (OR 3.361; 95% CI 1.016–11.117).

Heart disease, especially those related to rhythm disorders such as atrial fibrillation, is the main source of cardioembolism stroke. Cardioembolic strokes generally originate from thrombus formed due to blood stasis in the left chamber of the heart; the thrombus tends to be large so that it can block large-diameter brain blood vessels such as the medial cerebral artery, resulting in a larger infarction area and also heavier neurological deficits than other stroke subtypes (Sejawat, 2023). Atrial fibrillation is reported to increase the risk of ischemic stroke by 4–5 times (Lestari & Holisatul, 2025). Due to the mechanism of occlusion of large blood vessels, strokes originating from heart disease generally have a worse functional prognosis than

atherombotic and also laxinar strokes. These findings confirm the importance of cardiological evaluation, including heart rhythm examination, in each stroke patient to detect the source of cardioembolism as early as possible as a basis for secondary preventive management.

Relationship of Hyperlipidemia with GOS Category

Based on *Fisher's Exact Test*, hyperlipidemia was significantly associated with the GOS category (p=0.038), with an *unfavorable outcome* proportion of 66.7% in respondents with hyperlipidemia compared to 28.9% in respondents without hyperlipidemia (OR 4.909; 95% CI 1.223–19.709), which was the second highest OR value after a history of previous stroke.

Dyslipidemia, characterized by elevated LDL and also triglyceride concentrations alongside reduced HDL levels, contributes substantially to atherogenesis by promoting atheromatous plaque development within cerebral and also extracranial vascular walls (Journal of Pioneer Health, 2025). The triglyceride-to-HDL cholesterol ratio has also been associated with the clinical severity of acute ischemic stroke and also identified as a meaningful predictor of patient outcomes (And alsoaryani et al., 2017). From a management perspective, statin therapy for lipid regulation has been linked to improved functional outcomes among ischemic stroke patients, including those experiencing recurrent events (Alexxand alsoer et al., 2017). These findings therefore reinforce the clinical relevance of dyslipidemia screening and also management in supporting better stroke outcomes with *low expected* counts on cross-tabulation indicates the need for careful interpretation and also larger sample sizes in future studies.

Relationship of Previous Stroke History with GOS Category

Previous stroke history showed the strongest association with the GOS category (p=0.001; Cramer's V 0.491), with an *unfavorable outcome* proportion of 68.4% compared to 19.4% in respondents with no previous stroke history and also about nine times greater odds (OR 9.028; 95% CI 2.423–33.632).

Previous stroke history reflects previous brain tissue damage, so that the brain *reserve* to compensate for subsequent ischemic injury becomes increasingly limited. Each recurrent stroke episode has the potential to increase the cumulative burden of neurological damage, so the resulting functional deficit tends to be heavier than the first stroke. This condition also often reflects the control of vascular risk factors that have not been optimal in previous stroke episodes. Research on risk factors for recurrent ischemic stroke incidence report that hypertension and also diabetes mellitus, both stand also-alone and also concomitant, are the dominant determinants of recurrent stroke, and also non-adherence to therapy also accelerates the recurrence time (Panggabean et al., 2017). In addition, lipid profiles in patients with recurrent ischemic stroke tend to exhibit low HDL cholesterol levels and also high atherogenic lipid ratios (Fitriani, 2018), which strengthens the association between mutually aggravated vascular risk factors. Thus, the strong association between previous stroke history and also clinical outcomes confirms significance of comprehensive secondary prevention, encompassing sustained management of blood pressure and also blood glucose levels, and also lipid profiles.

Gender Relationship with GOS Category

The Chi-Square analysis indicated that no statistically significant association was identified between sex and also GOS category (p=0.991). The proportion *of unfavourable outcomes* in male patients was 38.1% and also in female patients was 37.9%, while the proportion of *favourable outcomes* in men was 61.9% and also in women was 62.1%. Odds *Ratio* value of 1.007 indicates that the *odds* of *unfavourable outcomes* in male patients are almost the same as in female patients, and also Cramer's V value of 0.002 indicates a very weak relationship. Thus, the two groups have relatively similar output distributions.

The findings regarding the distribution of sex can be compared with the outcomes of Sinurat et al. (2022) indicating that the majority of stroke patients were men, namely 63 people (63.64%) out of a total of 99 patients. However, the findings better describe the distribution of the patient's sex and also do not directly show the relationship between sex and also clinical outcomes based on GOS, so the difference in sex proportions between studies cannot be used as a basis to conclude that there is a difference in clinical outcomes. Meanwhile, the research of Mahendra et al. (2025) shows that the age group of >60 years is the group with the largest proportion (37.5%), while the age group of 31–40 years is 4.2%; the study is more relevant for the discussion of age characteristics than the relationship between sex and also clinical outcomes. The lack of a significant relationship between sex and also GOS categories indicates that stroke outcomes may be more strongly determined by other clinical factors, thereby requiring a broader interpretation of this association between sex and also stroke outcomes needs to consider patient characteristics and also other risk factors.

Research Limitations

The outcomes has several limitations. First, the analysis is restricted to bivariate assessment based on the Chi-Square and also Fisher's Exact tests. The vascular risk factors studied are interrelated and also can act as *confounding* factors; for example, hypertension and also diabetes mellitus are more commonly found in the elderly group, and also both conditions are also major risk factors for recurrent stroke. Therefore, the association found cannot be interpreted as an independent influence of each variable on clinical outcomes. Multivariate analyses such as multiple logistic regression were not performed because the number of *unfavorable outcome* events was only 19 out of 50 patients, so models with six to seven independent variables were at risk of being unstable and also *overfitting*. Adequate sample sizes for multivariable models need to be calculated formally based in terms of event frequency and also predictor variables (Riley et al., 2020).

Second, all cases of ischemic and also hemorrhagic stroke were analyzed as a single group without analysis by subtype, even though the two subtypes had different pathophysiological mechanisms, management, and also prognosis, with hemorrhagic strokes generally accompanied by higher acute phase mortality rates. Third, GOS was initially developed to assess the outcomes among individuals with traumatic brain injuries (McMillan et al., 2016); compared to mRS which is more commonly used as a functional outcome stand alsoard in stroke studies (Broderick et al., 2017), GOS is less sensitive in distinguishing degrees of mild to moderate disability. In addition, the severity of stroke upon hospitalization, for example based on NIHSS, is not analyzed, even though initial severity strongly influences patient outcomes (Rost et al., 2016).

Fourth, the GOS assessment was conducted when the patient was discharged from hospitalization and also did not include *a follow-up evaluation*, for example at the 3rd month after onset (Broderick et al., 2017), so the outcomes assessed were short-term outcomes. Fifth, the retrospective design caused the completeness of the data to be highly dependent on the quality of medical record recording. The relatively small number of samples (N = 50) and also coming from one hospital also limited the statistical strength and also generalization of the results. The wide confidence interval *of the Odds Ratio* on several variables, such as hyperlipidemia (95% CI 1.223–19.709) and also previous stroke history (95% CI 2.423–33.632), suggests that the large estimates of the relationship are still imprecise.

CONCLUSION

Drawing on findings from 50 stroke patients treated at Royal Prima Hospital Medan in 2026, the majority of patients were female and also elderly (≥60 years), with 31 patients (62.0%) having *a favorable outcome* and also 19 patients (38.0%) having *an unfavorable*

outcome based on GOS. A significant relationship was identified between age and also (p=0.031), diabetes mellitus (p=0.023), hypertention (p=0,024), heart disease (p=0.043), hyperlipidemia (p=0.038; *Fisher's Exact Test*), and also previous stroke history (p=0.001) with the clinical outcomes of stroke patients based on GOS, with previous stroke history having the highest association strength and also *odds*, while gender (p=0.991) showed no significant association. Hospitals and also health workers are advised to conduct comprehensive risk factor screening in each stroke patient as a basis for prognosis prediction, increase clinical awareness of elderly patients, individuals with prior stroke history and also those presenting multiple comorbid conditions, optimize secondary prevention through continuous management of blood pressure, glycemic levels, and also lipid parameters, and also conduct cardiological evaluations to detect the source of cardioembolism as early as possible. Patients and also families are advised to increase medication adherence and also routine control and also adopt a healthy lifestyle. Researchers are further advised to use a larger sample count, prospective cohort design with multivariate analysis such as multiple logistic regression, as well as adding other variables such as smoking habits, obesity, early stroke severity (NIHSS), time of onset to treatment, and also stroke subtypes.

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CONFLICT OF INTEREST

The authors confirm that the study, manuscript preparation, and also publication process involved no conflicts of interest.

AUTHOR'S CONTRIBUTION

All authors participated in developing this manuscript. Dwi Wuland alsoari (Author 1) was responsible for research conceptualization, data acquisition and also analysis, result interpretation, and also manuscript drafting. The remaining authors were involved in manuscript review, revision, and also final approval.

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The author confirms that generative artificial intelligence tools were not employed in preparing this manuscript.

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