Risk factors correlated with stroke in the population aged over 15 years in Semarang: a retrospective study

Aisyah Lahdji, Dwi Pudjonarko, Zahroh Shaluhiyah

ABSTRACT

**Background:** Stroke is the primary cause of mortality. Based on data from the World Stroke Organisation (WSO) for 2022, there would be an estimated 12.23 million cases of stroke, with 50% resulting in death. This study aimed to identify the factors that may influence the occurrence of stroke in the population aged ≥15 years in Semarang.

**Methods:** The study utilized secondary data obtained from hospitals in Semarang. The secondary data comprised medical information obtained from stroke patients. The study employed a retrospective and cross-sectional technique. The study employed frequency distribution analysis and chi-square for data analysis.

**Results:** 51.1% of stroke patients were female, categorized by sex. 67.7% of stroke patients were aged 55 and above, constituting the majority. Moreover, the predominant risk factor encountered by patients is coronary heart disease, constituting 53.7%. The duration of hospital admissions for stroke patients varied from 1 to 7 days, with the majority (74.7%) falling within this range. The Indonesian National Health Insurance (BPJS Kesehatan) emerged as the predominant source of health financing, accounting for 97% of cases. The duration of the stay is correlated with risk factors, including gender.

**Conclusions:** According to the study’s objectives, all variables that were investigated showed a statistically significant association with the occurrence of stroke. Stroke patients with coronary heart disease have the most prominent risk factors, followed by diabetes mellitus, renal failure, and hypertension. Moreover, a significant correlation was observed between gender and the risk variables experienced by those who had suffered from strokes. Moreover, the risk variables encountered by individuals who have suffered a stroke have a substantial influence on the duration of their hospitalization.

**Keywords:** Risk Factors, Stroke, Length of Stay, Sex.

INTRODUCTION

The primary challenge confronting the global health industry is the prevalence of unhealthy lifestyles or lifestyle choices. Unhealthy lifestyles are the primary cause of the elevated prevalence of non-communicable diseases, such as cardiovascular disorders (including stroke, hypertension, and diabetes). By 2030, it is projected that around 80% of the global population will consist of individuals with non-communicable diseases.

The World Health Organisation (WHO) reports that 41 billion individuals succumb to non-communicable diseases (NCDs) relative to the number of confirmed cases. Cardiovascular disease, which includes stroke, is the primary cause of mortality, resulting in 17.9 billion fatalities. Subsequently, cancer claims the lives of 9.3 billion individuals, lung impairment leads to the demise of 4.1 billion individuals, and diabetes is responsible for the deaths of 2 billion individuals.

Stroke is a complex disease with multiple contributing variables, and various factors can potentially trigger it. Certain variables, such as age and gender, are immutable and cannot be altered. Health status factors include hypertension, cardiovascular disease, diabetes mellitus, kidney failure, and diabetes mellitus. Behavioral aspects encompass activities such as exercise routines, dietary choices, and tobacco consumption. Furthermore, it is believed that socioeconomic factors, including geographic location, degree of education, and income, also play a role in the occurrence of stroke.

According to the 2022 report from the World Stroke Organisation (WSO), stroke has one of the highest mortality rates. The report states that there were 12.23 million instances of stroke, with 50% of those resulting in death. The majority of patients, at 7.6 million instances, are over 70 years old. Additionally, there are 1.9 million cases among patients aged 15-49 years. The global incidence of stroke is directly correlated with the incidence of stroke in Indonesia. According to the findings of the 2018 Basic Health Study in Indonesia (Riskesdas), the prevalence of stroke rose from 7 cases per 1,000 individuals in 2013 to 10.9 cases per 1,000 individuals in 2018. In 2018, there were a total of 96,794 stroke cases in Central Java. Among these instances, the age group of 15 to 24 years had the largest number of stroke cases, specifically 14,212 cases. Over the previous three years, the occurrence of stroke, diabetes mellitus, and hypertension in Semarang City has varied. According to the 2019 Central Java
Provincial Health Profile data, there were a total of 3,074,607 new instances of non-communicable diseases (NCDs) reported in 2019. Hence, the objective of this study is to ascertain the parameters linked to the occurrence of stroke in Semarang City.

**METHOD**

The study utilized secondary data obtained from hospitals in Semarang. The secondary data comprised medical information obtained from stroke patients. This study utilizes a retrospective and cross-sectional methodology, where the results are simultaneously revealed and seen in a single dataset. The inclusion criteria in this study were all stroke patients who were aged 15 years and over, patients who were being treated or had completed treatment, and patients who had risk factors. Meanwhile, the exclusion criteria are stroke patients who do not have risk factors. One thousand three hundred fifty-eight patients were identified based on the criteria for inclusion and exclusion. This study comprised stroke patients who had a previous medical history of risk factors. Consequently, the sampling method employed was complete sampling, which involved selecting the entire population consisting of 1,058 patients.

The stroke incidence was the dependent variable, while age, gender, hypertension, coronary heart disease, renal failure, and diabetes mellitus status were the independent factors. The statistical tests conducted included the analysis of frequency distribution and the chi-square test. The Medical Research Ethics Commission, K.R.M.T Wongsonegoro Regional Hospital, granted approval for this study under reference number 010/Kom.EtkR/SWN/XI/2023. The data utilized were authorized by the hospital and employed in accordance with the study’s stipulations.

**RESULTS**

Table 1 shows that women comprise 51.1% of stroke cases among individuals aged 15 and above in Semarang City. Over two-thirds, specifically 67.7%, of stroke patients were aged 55 and above. Additionally, those with risk factors for diabetes mellitus constituted the second largest group of patients, making up 36.7% of the total. Renal failure accounted for 7.8% of patients, while hypertension accounted for 1.8%. The duration of hospital admissions for stroke patients varied between 1 and 7 days, with the majority (74.7%) falling within this range. The Indonesian National Health Insurance (BPJS Kesehatan) emerged as the predominant source of health financing, accounting for 97% of cases.

### Table 1. Overview of Stroke Patient Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (N/%)</td>
<td>Man 517/48.9, Woman 541/51.1</td>
</tr>
<tr>
<td>Age (N/%)</td>
<td>&lt; 55 Years 313/29.6, 55 Years 29/2.7, &gt;55 Years 716/67.7</td>
</tr>
<tr>
<td>Risk Factors (N/%)</td>
<td>Diabetes Mellitus 388/36.7, Kidney Failure 83/7.8, Hypertension 19/1.8, Coronary Heart Disease 568/53.7</td>
</tr>
<tr>
<td>Length of Stay (N/%)</td>
<td>1 – 7 Days 790/100, 8 – 14 Days 216/100, More than 14 Days 52/4.9</td>
</tr>
<tr>
<td>Payment Method (N/%)</td>
<td>Out of Pocket 28/2.6, Private Health Insurance 4/0.4, Indonesian National Health Insurance (BPJS Kesehatan) 1,026/97</td>
</tr>
</tbody>
</table>

### Table 2. Relationship between Risk Factors and Length of Stay of Stroke Patients in Semarang

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Total (N/%)</th>
<th>X²</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Mellitus (N%)</td>
<td>Kidney Failure (N%)</td>
<td>Hypertension (N%)</td>
<td>Coronary Heart Disease (N%)</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>1 – 7 Days 288/36.7, 86/39.8, 14/26.9</td>
<td>62/7.8, 17/7.9, 4/7.7</td>
<td>8/1, 9/4.2, 2/3.8</td>
</tr>
<tr>
<td></td>
<td>8 – 14 Days 86/39.8, 14/26.9</td>
<td>83/7.8, 4/7.7</td>
<td>19/1.8</td>
</tr>
<tr>
<td></td>
<td>&gt;14 Days 14/26.9</td>
<td>790/100</td>
<td>14,595</td>
</tr>
<tr>
<td></td>
<td>Total (N%) 388/36.7, 86/39.8, 14/26.9</td>
<td>83/7.8, 17/7.9, 4/7.7</td>
<td>19/1.8</td>
</tr>
<tr>
<td></td>
<td>1,058/100</td>
<td></td>
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</tbody>
</table>

### Table 3. Relationship between Sex and Risk Factors of Stroke Patients in Semarang

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Total (N/%)</th>
<th>X²</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Mellitus (N%)</td>
<td>Kidney Failure (N%)</td>
<td>Hypertension (N%)</td>
<td>Coronary Heart Disease (N%)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male 163/31.5, Female 225/41.6</td>
<td>40/7.7, 43/7.9</td>
<td>6/1.2, 13/2.4</td>
</tr>
<tr>
<td></td>
<td>Total (N%) 388/36.7, 350/36.0</td>
<td>83/7.8, 76/7.9</td>
<td>19/1.8, 16/1.7</td>
</tr>
<tr>
<td></td>
<td>1,058/100</td>
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</table>
Table 2 illustrates a significant correlation between risk variables and the duration of hospitalization for stroke patients. The duration is categorized into three groups: 1-7 days, 8-14 days, and over 14 days. The chi-square test results indicate a statistically significant association, with a p-value below 0.05. Based on the data, stroke patients who have risk factors for coronary heart disease undergo the highest number of therapies for a duration exceeding 14 days, accounting for 61.5% of the cases. This is followed by patients with diabetes mellitus (26.9%), renal failure (7.7%), and hypertension (3.8%).

Table 3 demonstrates that gender exerts a substantial influence on the risk factors associated with stroke. The Chi-Square test resulted in a p-value of 0.001, demonstrating a significant association between gender and the risk factors of stroke patients. Men constitute the predominant proportion of risk factors for coronary heart disease (59.6%). Most individuals who are at risk for diabetes mellitus are female, making up 41.6% of the total.

DISCUSSIONS

Overview of Stroke Patient Characteristics

The findings indicate that there is no substantial disparity between genders among stroke patients. However, female stroke patients constitute 51.1% of the total, while male stroke patients make up 48.9%. Research conducted in Iran indicates that males had a twofold higher likelihood of experiencing a stroke during early adulthood compared to females. Males have a 25% to 30% higher likelihood of experiencing a stroke compared to females. Additionally, while men are more prone to having a stroke at a younger age, women are also more susceptible to strokes after menopause.

A study conducted in Germany produced identical results. The incidence of stroke in early adulthood, specifically between the ages of 18 and 40, is equally probable among both women and men. These findings indicate that both males and females are equally susceptible to experiencing a stroke throughout the early stages of adulthood. Male individuals have about 20% higher likelihood than female individuals to experience an ischemic stroke or brain hemorrhage. Nevertheless, women have a roughly 50% higher likelihood of experiencing subarachnoid haemorrhage. Ensuring gender parity in the occurrence of strokes during early adulthood (ages 18-40).

The results indicated that a significant proportion of individuals affected by stroke were aged 55 and above, constituting 67.7% of the total. Studies conducted in the Special Region of Yogyakarta revealed that individuals aged 55 and above had a 3.23-fold increased chance of experiencing a stroke compared to patients in younger age groups. A separate study carried out in East Java yielded similar findings: individuals aged 55 and above exhibited a 6.23-fold greater susceptibility to stroke compared to those under 55.

The results of this study confirm the concept that the risk of stroke rises as individuals become older, with the probability of experiencing a stroke doubling beyond the age of 55. Stroke is commonly known as an age-related disease due to the deterioration of the body’s organs, namely the loss of flexibility in the blood arteries of the brain.

The findings indicated that a significant proportion of stroke patients (53.7%) exhibited risk factors associated with coronary heart disease. Among stroke patients, 36.7% had risk factors for diabetes mellitus, 7.8% had risk factors for renal failure, and 1.8% had risk factors for hypertension. Previous research investigating risk factors for stroke has found that individuals who have had a stroke are at the greatest risk of developing coronary heart disease. Specifically, individuals aged 55 or older have a 60.6% chance of developing coronary heart disease, which is higher than the risk associated with other factors.

Cerebral ischemia can arise as a consequence of cardiovascular disease or other pathological conditions. An irregular pulse leads to a decrease in overall cardiac output, which in turn affects the amount of blood supplied to the brain, causing ischemia. In addition, emboli are discharged, causing obstruction of cerebral blood vessels. This condition is referred to as ischemic stroke, which is caused by thrombosis. Individuals with cardiovascular disease or arrhythmias have a tripled likelihood of experiencing a stroke in comparison to those who do not have these conditions. An electrocardiogram (ECG) is a diagnostic test used to identify and evaluate heart abnormalities.

Diabetes mellitus exacerbates arteriosclerosis in both small and large blood vessels, including those in the brain and heart. Elevated blood glucose levels lead to blood viscosity, impeding cerebral blood circulation. Hyperglycemia hinders the production of prostacyclin, a substance that widens the blood vessels, promotes blood clot formation, and leads to the breakdown of proteins in the arterial wall. Diabetes mellitus can also elicit alterations in the vascular system, including blood vessels and the heart. Diabetes mellitus hastens the progression of arteriosclerosis, resulting in a more severe and widespread condition, hence elevating the risk of mortality in stroke patients. Patients with a prior diagnosis of diabetes mellitus who experience a stroke may possess a genetic inclination towards diabetes mellitus, which is intensified by an unhealthy lifestyle characterized by excessive consumption of sugary foods and fast food without the counterbalance of regular exercise or physical activity. Signs of diabetes mellitus encompass the classical triad symptoms, along with an evaluation of GDR, GDS, and HbA1c levels.

Hypertension leads to the rupture of cerebral blood vessels, causing a cerebral haemorrhage. Hypertension can affect almost every organ in the body, especially the brain, heart, kidneys, eyes, and peripheral blood vessels. The likelihood of complications is contingent upon the magnitude of blood pressure, the duration of its elevation, the extent of its increase from a prior state, and the existence of additional risk factors. According to the data, 74.7% of individuals who had a stroke needed to be admitted to the hospital for a duration ranging from 1 to 7 days. Studies conducted in the United States indicate that stroke patients had an average hospital stay of 5.22 days. Meanwhile, a study conducted in Taiwan revealed that the majority of individuals who suffer from a stroke often stay in the hospital for a duration of 13 days. Moreover, a staggering 97% of individuals...
who have suffered from a stroke decide to utilize the Indonesian National Health Insurance (BPJS Kesehatan) as their method of payment. The Health Social Security Organisation (BPJS), responsible for managing national health insurance with the aim of achieving Universal Health Coverage (UHC), has declared that stroke funding ranks third in terms of national priorities. Expenditures experienced a rise from 2016 to 2022. In 2016, BPJS Kesehatan incurred a cumulative expense of IDR 1.43 trillion for stroke, which increased to IDR 2.19 trillion in 2017, IDR 2.57 trillion in 2018, and IDR 3.23 trillion in 2022.21

**Relationship between Risk Factors and Length of Stay of Stroke Patients in Semarang**

The results demonstrated a strong and statistically significant correlation between risk factors and the duration of hospitalization for stroke patients. The duration of hospitalization was categorized into three groups: 1-7 days, 8-14 days, and more than 14 days. The chi-square test results indicate a statistically significant association, with a p-value below 0.05. Based on the data, stroke patients who have risk factors for coronary heart disease undergo the highest number of therapies for a duration exceeding 14 days, accounting for 61.5% of cases. This is followed by patients with diabetes mellitus (26.9%), renal failure (7.7%), and hypertension (3.8%).

The study's conclusions align with research carried out in Malaysia. The presence of stroke risk factors significantly impacts the duration of hospitalization for stroke patients (P=0.001).22 The duration of therapy is directly proportional to the severity of the patient's risk factors. A study conducted in the United States has found a correlation between the duration of hospitalization for stroke patients and certain patient risk factors, namely coronary heart disease, diabetes mellitus, hypertension, and renal failure.23

**Relationship between Sex and Risk Factors of Stroke Patients in Semarang**

The study's findings suggest that gender exerts a substantial influence on the risk variables associated with stroke. The Chi-Square test resulted in a p-value of 0.001, demonstrating a significant association between gender and risk factors in stroke patients. Men constitute the predominant proportion of risk factors for coronary heart disease, amounting to 59.6%. Concurrently, women make up 41.6% of the total number of cases of diabetes mellitus.

Research conducted in Ethiopia indicates that men have a significantly higher risk than women (P-value=0.001). According to the study, the majority of stroke patients who had risk factors for coronary heart disease were of the male gender.24 Additional inquiries align with the discovered results. Women have a 2.28 times higher prevalence of stroke patients with risk factors for diabetes mellitus compared to men.25

A limitation of this study is the need to gather more extensive data on comorbid disorders such as diabetes mellitus, coronary heart disease, and hypertension. Specifically, the study requires information on the duration of these diseases in patients who have experienced them as risk factors. Therefore, considering these constraints, studies that are intended to be conducted as a supplement are those that completely examine all lifestyle-related risk factors and concomitant disorders.

**CONCLUSION**

According to the study's objectives, all variables analyzed were determined to have a statistically significant correlation with the occurrence of stroke. Stroke patients with coronary heart disease exhibit the most elevated risk factors, followed by diabetes mellitus, renal failure, and hypertension. Moreover, there was a significant correlation between gender and the risk variables experienced by those who had suffered a stroke. Moreover, the risk variables encountered by individuals who have had a stroke have a substantial influence on the duration of their hospitalization.

**ACKNOWLEDGMENTS**

We express our gratitude to the Head of Medical Records and the entire team at K.R.M.T Wongsonegoro General Hospital for their participation in this study and for granting us permission to access secondary data in the form of medical records pertaining to stroke disease.

**ETHICAL CLEARANCE**

The research was approved by the Ethical Committee under reference number 010/Kom.EtikRSWN/XI/2023 of K.R.M.T Wongsonegoro Regional Hospital.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

**FUNDING**

The study did not receive any grants or funding.

**AUTHOR'S CONTRIBUTION**

All authors made substantial contributions to the conception and design of the study, the collection of the data, the analysis and interpretation of data, the drafting of the article, the critical revision of the article for important intellectual content, and the final approval of the version to be published.

**REFERENCES**


