

## Risk factor profile of ischemic stroke in inpatients of the neurology department of Dr. Soetomo General Hospital, Tertiary Hospital in Indonesia

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### Abstract

**Background:** Stroke is a leading cause of deaths worldwide. Stroke is a neurological deficit caused by vascular issues. Stroke is divided into 2, hemorrhagic and ischemic, with ischemic being the most prevalent type. Management of risk factors is vital in lowering the incidence of ischemic stroke. As such, constant surveillance and description of risk factors are pivotal.

**Objective:** to describe the risk factor profile of ischemic stroke in inpatients of the neurology department of Dr. Soetomo General Hospital in January 2024-June 2024

**Method:** This research uses retrospective descriptive method.

**Results:** The results of this research found 141 patients (70%) were in the <65 year age group, 117 male patients (58%), 69 patients (37%) with previous stroke history, 100 patients (49%) with grade 2 hypertension, 123 patients (62%) with history of hypertension, has desired levels of total cholesterol numbering 102 patients (62%), near optimal levels of LDL-C numbering 53 patients (32%), low levels of HDL numbering 80 patients (49%), normal levels of triglyceride numbering 105 patients (65%), with diabetes mellitus 87 patients (44%), with history of diabetes mellitus numbering 71 patients (36%), and has smoking habits numbering 45 patients (49%).

**Conclusion:** Prominent risk factors found are <65 year age group, male sex, previous stroke history, history of hypertension, grade 2 hypertension, low HDL, near optimal LDL-C, borderline high triglyceride, borderline high total cholesterol, and smoking.

**Keywords:** Profile; Ischemic stroke; Risk factor; Doctor Soetomo General Hospital; Sex; Age; Stroke history; Hypertension; History of hypertension; Diabetes mellitus; History of diabetes Mellitus; Dyslipidemia; Smoking

### 1. Introduction

Stroke is generally indicated as a neurological injury of the central nervous system (CNS) caused by vascular problems. Stroke is an umbrella term that covers CNS infarction, ischemic stroke, silent CNS infarction, stroke caused by intracerebral hemorrhage, silent cerebral hemorrhage, subarachnoid hemorrhage, stroke caused by intracerebral hemorrhage, stroke caused by cerebral venous thrombosis, and unspecified stroke [1]. Stroke is known to be a major

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cause of long-term disability in adults. Furthermore, stroke is found to be the second leading cause of death worldwide and the third leading cause of DALYs (disability-adjusted life year) [4, 7]. Stroke is divided into two types, ischemic and hemorrhagic stroke with ischemic stroke being the most common type of stroke with 87% of all strokes being ischemic stroke [2, 3, 5].

According to the 2019 GBD (Global Burden of Disease), the prevalence of stroke in 2019 was 101,474,558 with 77,192,498 of them being ischemic stroke. Not only that, stroke has caused 6,552,724 deaths around the globe. Furthermore, from 1990 to 2019 the total number of stroke-related DALYs due to risk factors skyrocketed with a disconcerting 33.5 million difference between the two [7].

According to *Riset Kesehatan Dasar* (Riskesdas) 2018 [10], the prevalence of stroke in Indonesian people at the age of  $\geq 15$  years old is 1.09%. In addition to that, stroke occurs the most in citizens at the age of  $\geq 75$  years old being 5.09%. On the other hand, stroke occurs the least in the age group 15-24 years old (0.06%) [10, 11]. In Surabaya, the incidence rate of ischemic stroke is around 72.6% conversely the incidence rate of hemorrhagic stroke is 27.39% with males having a considerably higher incidence rate (56.2%) than females (43.8%) [8].

Risk factors for stroke are generally categorized into two categories, modifiable and nonmodifiable risk factors. Nonmodifiable risk factors for stroke include age, sex, and previous stroke history. Whereas the modifiable risk factors of stroke are hypertension, diabetes mellitus, heart disease, dyslipidemia, obesity, smoking, and alcohol abuse [9, 6]. The most prevalent risk factors according to the 2019 GBD are hypertension, obesity, diabetes mellitus, smoking, and "ambient particulate matter" [7].

The above discussion shows that stroke has a very high mortality rate worldwide. Furthermore, the prevalence of stroke is also high both globally and nationally. In addition, there seems to be an increase in the incidence of stroke in the past decade which is attributed to its risk factors. Moreover, the risk factors for stroke in Indonesia are still quite high. This is the reason why this research was made. Since the prevalence of ischemic stroke is higher than other types of strokes thus this research will focus more on ischemic stroke and its risk factors.

## 2. Material and methods

This research is a descriptive study that aims to explain the risk factor profile for ischemic stroke of inpatients of the neurologic ward of Doctor Soetomo General Hospital from January-June 2024 by using secondary data in the form of medical records in the Doctor Soetomo General Hospital. The population in this research is the medical records of ischemic stroke patients in the neurology ward of Doctor Soetomo General Hospital from January-June 2024. The sampling method used in this research is the total sampling method. This method uses all the medical records of every patient recorded with ischemic stroke from January-June 2024 in the inpatient neurology ward of Doctor Soetomo General Hospital.

### 2.1. Ethics

This research has been approved by the Committee for Research Ethics of Doctor Soetomo General Hospital (No. 1696/LOE/301.4.2/VI/2024). The patients' names are not disclosed in this research to maintain confidentiality. All data collected will only be maintained and used by the author for the purpose of this research.

## 3. Results

The amount of ischemic stroke patients in January-June 2024 in the Neurology Seruni A ward of Doctor Soetomo General Hospital is 206.

**Table 1** Age Distribution

| Age (years) | N (n=206) | %  |
|-------------|-----------|----|
| <65         | 143       | 69 |
| $\geq 65$   | 63        | 31 |

Based on table regarding the age distribution, it can be seen that it is dominated by patients in the age category of <65 years with 143 patients (69%) meanwhile the older age category of ≥65 years only contributes 63 patients (31%).

**Table 2** Sex Distribution

| Sex    | N (n=206) | %  |
|--------|-----------|----|
| Male   | 119       | 58 |
| Female | 87        | 42 |

From table 2 regarding sex distribution, it can be seen that males dominate the disease with 119 patients accounting for 58%, whereas females with 87 patients account for 42%.

**Table 3** Previous Stroke History

| Previous Stroke History | N (n=193) | %  |
|-------------------------|-----------|----|
| Yes                     | 73        | 38 |
| No                      | 120       | 62 |

From table 3 regarding previous stroke history, it can be surmised that the majority of patients have never been diagnosed with stroke prior to the recorded admittance making up 63% with 120 patients. Only 73 patients were recorded with having a stroke episode prior to the recorded admittance making up 38%.

**Table 4** Hypertension Distribution

| Hypertension            | N (n=206) | %  |
|-------------------------|-----------|----|
| Normal Blood Pressure   | 24        | 12 |
| Elevated Blood Pressure | 12        | 6  |
| Grade 1 Hypertension    | 38        | 18 |
| Grade 2 Hypertension    | 102       | 49 |
| Hypertensive Crisis     | 30        | 15 |

From table 4 regarding the distribution of hypertension, it can be seen that the category is dominated by grade 2 hypertension with 102 patients making up 49% of patients recorded. This is followed by grade 1 hypertension with 38 patients (18%) then hypertensive crisis with 30 patients (15%), normal blood pressure with 24 patients (12%). Lastly, elevated blood pressure with only 12 patients making up 6%.

**Table 5** History of Hypertension

| History of Hypertension | N (n=202) | %  |
|-------------------------|-----------|----|
| Yes                     | 127       | 63 |
| No                      | 75        | 37 |

From table 5 regarding history of hypertension, most patients come with pre-existing history of hypertension numbering 127 people (63%) with a history of hypertension. Subsequently, patients without prior diagnosis of hypertension amount to 75 people (37%).

**Table 6** Total Cholesterol Levels

| Total Cholesterol Levels | N (n=168) | %  |
|--------------------------|-----------|----|
| Desired                  | 105       | 62 |
| Borderline High          | 33        | 20 |
| High                     | 30        | 18 |

In table 6 regarding total cholesterol levels, the majority of patients have desired levels of total cholesterol with 105 patients (62%). This is followed by patients with borderline levels of total cholesterol with 33 patients (20%). Only with slight difference, there are 30 patients with high levels of total cholesterol.

**Table 7** LDL-C Levels

| LDL-C Levels    | N (n=168) | %  |
|-----------------|-----------|----|
| Optimal         | 34        | 20 |
| Near Optimal    | 54        | 32 |
| Borderline High | 39        | 23 |
| High            | 26        | 16 |
| Very High       | 15        | 9  |

In table 7 regarding low density lipoprotein (LDL) levels, there are 54 patients (32%) with near optimal levels of LDL, dominating this category. 39 patients (23%) have borderline high levels of LDL, 34 patients (20%) have optimal LDL levels, 26 patients (16%) have high LDL levels, and 15 patients (9%) have very high levels of LDL.

**Table 8** HDL Levels

| HDL Levels | N (n=167) | %  |
|------------|-----------|----|
| Low        | 81        | 49 |
| Normal     | 79        | 47 |
| High       | 7         | 4  |

In table 8 regarding high density lipoprotein (HDL) levels, the majority have low HDL levels with 81 patients making up 49%. This is followed by, 79 patients (47%) with normal HDL levels and only 7 patients (4%) with high HDL levels.

**Table 9** Triglyceride Levels

| Triglyceride Levels | N (n=164) | %  |
|---------------------|-----------|----|
| Normal              | 107       | 65 |
| Borderline High     | 34        | 20 |
| High                | 22        | 14 |
| Very High           | 1         | 1  |

In table 9 regarding triglyceride levels, 107 patients (65%) have normal triglyceride levels, the majority of this category. This is followed by 34 patients (20%) with borderline high levels of triglyceride. 22 patients (14%) have high levels of triglyceride. And, only 1 patient (1%) have very high level of triglyceride.

**Table 10** Diabetes Mellitus

| Diabetes Mellitus | N (n=204) | %  |
|-------------------|-----------|----|
| Yes               | 89        | 44 |
| No                | 115       | 56 |

From table 10, patients without diabetes mellitus seem to be the majority with 115 patients (56%). Meanwhile the remaining that seem to have diabetes mellitus numbers 89 patients (44%).

**Table 11** History of Diabetes Mellitus

| History of Diabetes Mellitus | n(n=200) | %  |
|------------------------------|----------|----|
| Yes                          | 72       | 36 |
| No                           | 128      | 64 |

Patients that have not been diagnosed with diabetes mellitus prior dominate this category with 128 patients (64%). On the other hand, patients that have been diagnosed with diabetes mellitus make up 36% with 72 patients.

**Table 12** Smoking Habits

| Smoking Habits | n  | %  |
|----------------|----|----|
| Yes            | 46 | 49 |
| No             | 48 | 51 |

In table 12 regarding smoking habits, it can be surmised that there is only a slight difference in the amount of patients who smoke and patients who do not with only a 2% difference. There are 48 patients (51%) who do not smoke and 46 patients (49%) who smoke.

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## 4. Discussion

### 4.1. Nonmodifiable Risk Factor

#### 4.1.1. Age

The dominant age group is the <65-year age group. This age group consists of 143 people of 202 people accounting for 69% of the total patients. This aligns with a similar study done by Artanti et al [8] that studied risk factors on types of strokes in Doctor Soetomo General Hospital in January-October 2018 which found 35 patients (66%) of ischemic patients were within the <65 year age group. Consequently, the same study also had similar findings in the ≥65 year age group, where said age group accounted for 34% with 18 patients.

According to Hathidara, Saini and Malik [12], the increased trend of stroke in younger populations may be contributed to changes in lifestyle such as increasing growth of sedentary lifestyles, lack of exercise, dietary changes specifically increased sugar, salt and processed food, as well as substance abuse such as tobacco. The etiology of increased incidence of stroke in younger populations may be acquitted to among others, large vessel disease atherosclerosis, cardio-embolism, and small vessel disease. Large artery disease as well as cardio-embolism being the major contributors for this trend [13].

#### 4.1.2. Sex

The findings of this research showed that males were the dominant sex in ischemic stroke. There are 119 patients (58%) that are males with a noticeable difference with females, 87 patients (42%). These results are similar to a research done in Bethesda Hospital in Jogjakarta from 2011-2013, discussing the epidemiology of stroke, which found 1417 patients (57.6%) were males whilst the females were 1043 patients (42.4%) [14]. Similarly, a research done in Prof. Dr. R. D. Kandou General Hospital in Manado regarding risk factors of ischemic stroke done in July 2012-June 2013 showed that

males were also the dominant sex accounting for 55%, 33 patients. Whereas, females accounted for 45% with 27 patients [15].

This demonstrates that men may be more susceptible to ischemic stroke than women. One reason this may be, can be due to the protective nature of endogenous estrogen against stroke. Another, may be due to the higher prevalence of hypertension in the male population. In addition, incidences of ischemic heart disease, peripheral artery disease, and smoking are higher in men, these contribute to macrovascular diseases [16].

#### *4.1.3. Previous Stroke History*

This research found that the majority of patients does not have a previous history of stroke. This group of patients consist of 120 patients (62%), whereas patients who have had prior stroke(s) makes up 38%, 73 patients. This is also similar to findings in a research done in dr. Zainoel Abidin Hospital in Banda Aceh, done in July-September 2022, studying risk factors, hemoreological disorders, and outcome in ischemic stroke patients. The study found that majority of patients, 76 patients (84%), did not have a previous stroke. Consequently, the study found only 14 patients (16%) with previous stroke history [17]. Another study done in Fatmawati General Hospital in 2016-2018 that researches about risk factors relating to recurrent stroke found 47 patients (60.3%) had not experienced stroke prior. The study found only 31 patients (39.7%) were admitted to the hospital for a recurrent episode of stroke [18].

The incidence of stroke indicates that the patient may already have existing risk factors for stroke. This means that patients with stroke history are more likely to experience it again. Detailed and precise examination of risk factors is vital as swift management of risk factors can influence stroke recurrence [19, 20].

## **4.2. Modifiable Risk Factor**

### *4.2.1. Hypertension*

The results of this study found that the leading group for hypertension present in ischemic stroke patients are patients with grade 2 hypertension. Patients with grade 2 hypertension numbers to 102 patients (49%). This is followed by patients with patients with grade 1 hypertension, 38 patients (18%), then patients with hypertensive crisis, 30 patients (15%), then patients with normal blood pressure, 24 patients (12%), last is patients with elevated blood pressure, 12 patients (6%). These results align with a similar study done in Ibnu Sina Hospital in Makassar done in 2020-2022 that found the dominant group for hypertension is patients with grade 2 hypertension, 65 patients (44%) and followed by grade 1 hypertension, 37 patients (25%) [21]. Another study done in Klungkung General Hospital in October 2017-September 2018 found 39 patients (60%) with blood pressure higher than 140/90 mmHg which is the majority in the study. This was followed by 120-130/80-89 mmHg with 17 patients (26.2%) [22].

Hypertension increases the progressivity of atherosclerosis, a known mechanism causing stroke as this can cause large artery atherosclerosis. In addition, hypertension also causes endothelial dysfunction and smooth muscle remodeling that causes lumen narrowing. Occlusions and emboli are more prone to happen in patients with chronic hypertension [23, 24].

### *4.2.2. Dyslipidemia*

#### **Total Cholesterol**

The results found the largest group of patients had desired levels of total cholesterol, 105 patients (62%). This is followed by 33 patients (20%) with borderline high levels and then 30 patients (18%) with high levels. These findings are comparable with a study done in Klungkung Hospital which found the majority of ischemic stroke patient had total cholesterol levels <200 mg/dl, 25 patients (86.2%) [22].

#### **LDL-C**

The results showed that the majority of patients had near optimal levels of LDL-C with 54 patients (32%) and the smallest group is patients with very high levels of LDL-C with only 15 patients (9%). This is consequent with findings of a similar research done in Prof. Kandou General Hospital in Manado which found 45 patients (33%) had near optimal levels of LDL-C which is the majority in the study. Additionally, the smallest group are patients with very high levels of LDL-C with 12 patients (9%) [28]. However, these results do not align with a study done in Arifin Achmad General Hospital which found the largest group of patients to be with optimal levels of LDL-C, 42 patients (28%). Meanwhile patients with near optimal levels of LDL-C numbers 33 patients (22%) [29].

## HDL

Results from this study found the largest group had 81 patients (49%), had low levels of HDL and the smallest group had 7 patients (4%) had high levels of HDL. These results align with a study done in Prof. Kandou General Hospital that found that the largest group of patients are patients with low levels of HDL, 69 patients (51%), and smallest group are patients with high levels of HDL, 13 patients (10%) [28]. However, it does not align with a research in Arifin Achmad General Hospital that found most patients had medium levels of HDL, 83 patients (55.3%). Whereas, the research found 53 patients (35.3%) with low levels of HDL [29].

## Triglyceride

Results showed that most patients had normal levels of triglyceride, 107 patients (65%). Meanwhile only 1 patient (1%) had very high levels of triglyceride. These findings match with a study done in Arifin Achmad General Hospital that found 99 patients (66%) had optimal levels of triglyceride [29].

Dyslipidemia causes a build-up of lipid plaque in blood vessels that are at risk of rupture causing emboli. These plaques also cause the lumen of the blood vessels to narrow and can promote atherosclerosis. Furthermore, dyslipidemia can also cause hypertension and worsen it, increasing the risk of ischemic stroke [25, 26, 27].

### 4.2.3. Diabetes Mellitus

The results from this study showed that the majority of patients did not have diabetes mellitus, 115 patients (56%). Meanwhile, patients who did have diabetes mellitus numbered 89 patients (44%). These results are similar with research done in Zainoel Abidin General Hospital that found the majority of ischemic stroke patients did not have diabetes mellitus. The study found 55 patients (61%) do not have diabetes mellitus and 35 patients (39%) have diabetes mellitus [17]. Another study done in Prof Kandou General Hospital also found that most ischemic stroke patients did not have diabetes mellitus, 44 patients (73.4%), and only 16 patients (26.6%) have diabetes mellitus [15].

The same pattern can be seen in the history of diabetes mellitus, there are more patients without history of diabetes mellitus, 128 patients (64%), than there with history of diabetes mellitus, 72 patients (36%), in this research. These findings are similar with a study done in Arifin Achmad General Hospital that found 109 patients (72.7%) without history of diabetes mellitus and 41 patients (27.3%) had history of diabetes mellitus [29].

Diabetes mellitus can increase the risk for stroke in a number of ways, diabetes mellitus creates a condition of chronic inflammation and arterial stiffness causing atherosclerosis. Not only that, diabetes mellitus also causes endothelial dysfunction. Diabetes mellitus also plays a role in conditions such as hypertension, metabolic derangements, dyslipidemia, and microvascular diseases. All this can lead up to ischemic stroke [30].

### 4.2.4. Smoking

Results showed 48 patients (51%) does not have a smoking habit and 46 patients (49%) has a smoking habit. There is very little difference between the amount of the two categories but there are more patients who do not smoke than there are who do. These findings align with a study done in Klungkung General Hospital which found ischemic 37 ischemic stroke patients (56.9%) do not smoke [22]. Be that as it may, a study done in Prof Kandou General Hospital, studying smoking habits in ischemic stroke patient done in November-December 2014, found that the majority of patients do smoke. The study found 24 patients (57.1%) with smoking habits and 18 patients (42.9%) without smoking habits [31].

Smoking causes the progressivity of atherosclerosis. This is done through platelet aggregation, decrease in HDL levels, increase in fibrinogen levels, carboxyhemoglobinemia, and toxic radicals [32].

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## 5. Conclusion

Nonmodifiable risk factors found in ischemic stroke patients of Dr. Soetomo General Hospital were <65 year age group numbering 141 patients (70%), males numbering 117 patients (58%), with previous history of stroke numbering 69 patients (37%). Modifiable risk factors found were history of hypertension, 127 patients (63%), grade 2 hypertension, 102 patients (50%), diabetes mellitus, 89 patients (44%), low HDL, 81 patients (49%), history of diabetes mellitus, 72 patients (36%), near optimal LDL, 54 patients (32%), smoking habits, 46 patients (49%), borderline high triglyceride, 34 patients (21%), borderline high total cholesterol, 33 patients (20%).

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare no conflicts of interest.

### *Statement of ethical approval*

This research has been granted ethical clearance by the Committee for Research Ethics of Doctor Soetomo General Hospital (No. 1696/LOE/301.4.2/VI/2024).

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