Incidence of Stroke and Associated Risk Factors in Bogor, Indonesia: A Nested Case-Control Study

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Abstract
The increasing number of stroke cases and their risk factors is a crisis that needs to be addressed. This study aimed to determine the number of new stroke cases in Bogor, Indonesia, and its risk factors. We conducted a nested case-control study from the Study of Non-Communicable Disease (NCD) Risk Factors of the National Health Institute of Research and Development, Ministry of Health, Indonesia, in 2018. A deep analysis was conducted on 1,210 respondents based on the subset of baseline this data. Data was collected by interview method on permanent residents in Bogor City, Indonesia in 2018. Diagnosis of stroke was based on the anamnesis of a neurologist and a neurological examination. Independent variables include sociodemographic characteristics, metabolic syndrome, and risky behaviors. The data was analyzed with a dual logistic regression test. The incidence of stroke during 2018 amounted to 48 cases (3.9%). The main determinants of stroke in this population include diabetes mellitus and systolic blood pressure being the main factors for stroke, with each p-value, AOR, and (95% CI) being 0.000, 0.222 (0.122-0.405), 0.003, 0.291 (0.128-0.662). There was no significant difference in metabolic syndrome outcomes one year before the diagnosis of stroke and the year when the stroke was diagnosed. Special attention is needed in DM patients with high blood pressure to prevent stroke.

Introduction
The cause-specific death rate of stroke reaches 5.5 million deaths, and more than 116 million stroke patients with complications including disability each year (Kim et al., 2020; Lindsay et al., 2019; World Stroke Organization, 2019). More than 80 million people had a history of stroke in 2016, and more than 13.7 million new cases each year (Kim et al., 2020). Globally, it is estimated that one in four people over the age of 25 will have a stroke during their lifetime. Over the past four decades, the incidence of stroke in lower-middle-income countries has more than doubled (Johnson et al., 2016), worldwide stroke deaths have most occurred in developing countries, such as Indonesia, which contributes 75.2% of all deaths (Feigin et al., 2014; Kim et al., 2020; Thomas et al., 2018).

The prevalence of Stroke in Indonesia increased from 7% in 2013 to 10.9% or estimated as many as 2,120,362 people had strokes in 2018 (Badan Penelitian dan Pengembangan Kesehatan, 2018). It is becoming the first cause of death in Indonesia [8,9], with 21.1% of deaths in Indonesia caused by stroke. The non-communicable diseases (NCD) cohort study in Kebon Kelapa, Bogor, showed that stroke became a disease with the first fatality rate (Kemenkes RI, 2018). Despite its enormous impact on the socio-economic development of the country, this growing crisis, stroke has lack of attention to date (Johnson et al., 2016).

The metabolic risk factors of stroke are hypertension, obesity, and diabetes mellitus...
(Boehme et al., 2017; Hasnah, 2020; Lee et al., 2018; Setyopranoto et al., 2019; WHO, 2018). Indonesia’s basic health research (riset kesehatan dasar=RISKESDAS) report shows that the prevalence of these risk factors has increased. The prevalence of hypertension for people aged >18-years-old increases from 25.8% to 34.1%. The prevalence of obesity in the >18-year-old increases from 14.8% to 21.8%. And diabetes mellitus in the ≥ 15-year-old increases from 6.9% to 10.9% (Badan Penelitian dan Pengembangan Kesehatan, 2018). This study aimed to find the number of new cases during 2018 and their risk factors based on the data from NCD risk factors cohorts conducted by the National Health Institute of Research and Development, the Ministry of Health of the Republic of Indonesia (MoH RI).

Methods
This study was a secondary data analysis that used research data of the NCD Risk Factor Cohort Study in Bogor City in 2017-2018 from the Ministry of Health of the Republic of Indonesia and was a community-based prospective cohort study. Respondents registered in the cohort study in 2017-2018 amounted to 3,784 respondents. Of it, 1,210 respondents had carried out stroke confirmation examinations. Dependent variables are strokes categorized into strokes and not strokes based on the results of neurological studies and confirmation of stroke by a neurologist. The independent variables that were potentially associated with stroke were age, gender, and education level (categorized into low education for junior school or lower, and higher education for high school up to college). Type of job by private employees/entrepreneurs and civil servants. Respondents’ incomes are categorized as < CMW and ≥ CMW. Health insurance has and does not. Smoking status in the past year as smoking and not smoking; The age of smoking started by ≤ 15 years and > 15 years. Alcohol consumption. Physical activity by strenuous and light. Diabetes Mellitus. Emotional distress status (stress) was classified as stress if the respondents experienced at least 6 out of 20 symptoms in the Instrument Self Reporting Questionnaire (SRQ). Metabolic syndrome factors include fasting blood glucose levels, post-loading blood glucose, total cholesterol, LDL, HDL, triglyceride, systolic blood pressure, diastolic blood pressure, and body mass index (BMI). Risk categories include fasting blood glucose ≥ 125 mg/dL, postprandial blood glucose ≥ 180 mg/dL, total cholesterol ≥ 200 mg/dL, LDL ≥ 100 mg/dL, HDL < 40 for men and < 50 for women and triglycerides ≥ 150 mg/dL, systolic blood pressure ≤ 120 mmHg, diastolic blood pressure ≤ 80 mmHg, and BMI classified as normal and obese (≥ 27).

Data were presented as frequencies and percentages based on variable categories. Bivariate analysis is used to identify risk factors associated with stroke incidence. In the absence of collinearity, all variables were included in the logistic regression model using a gradual method to determine the associated variable (p < 0.05). Odds ratio (OR) with a confidence interval of 95% (CI) was calculated as a measure of association. In addition, the Mann-Whitney test was conducted to find out the difference in risk factors for metabolic syndrome years before the stroke was diagnosed with the year of the stroke diagnosis. All analyses were conducted by SPSS 22.0 (IBM Corporation, NY, USA). This cohort data source had received updated ethical approval every year from the Health Research Ethics Commission, Health Research and Development Agency, Ministry of Health of the Republic of Indonesia. Research ethics permit in 2017 number LB.02.01/5.2/KE.108/2017. No further ethical permission was required for the analysis of secondary data.

Results and Discussion
Based on the research that has been done, the following results were obtained:
## Table 1. Characteristics of Research Respondents

| Variable                                      | Frequency | Percent |
|-----------------------------------------------|-----------|---------|
| **Age (mean; SD)**                            | 43.3; 10.14 |         |
| **Gender**                                    |           |         |
| Male                                          | 419       | 34.6    |
| Female                                        | 791       | 65.4    |
| **Education**                                 |           |         |
| Low (Not School - Junior school)              | 734       | 60.7    |
| High (high school - college)                  | 476       | 39.3    |
| **Type of work**                              |           |         |
| Private employee/entrepreneur                 | 1182      | 97.7    |
| Civil Servants                                | 28        | 2.3     |
| **Income (CMW = Rp 3.557.146)**              |           |         |
| < city minimum wage                           | 1154      | 95.4    |
| ≥ city minimum wage                           | 56        | 4.6     |
| **Ownership of Health Insurance**             |           |         |
| It doesn't have                               | 424       | 35.0    |
| Have                                          | 786       | 65.0    |
| **Smoking Status**                            |           |         |
| Smoke                                         | 665       | 55.0    |
| No smoking                                    | 545       | 45.0    |
| **Age to Start Smoking**                      |           |         |
| ≤ 15 years                                    | 267       | 22.1    |
| > 15 years                                    | 943       | 77.9    |
| **Alcohol Consumption**                       |           |         |
| Yes                                           | 255       | 21.1    |
| Not                                           | 955       | 78.9    |
| **Physical Activity**                         |           |         |
| Heavy                                         | 64        | 5.3     |
| Light                                         | 1146      | 94.7    |
| **Diabetes Mellitus**                         |           |         |
| Positive                                      | 181       | 15.0    |
| Negative                                      | 1029      | 85.0    |
| **Emotional Mental Disorders**                |           |         |
| Annoyed                                       | 160       | 13.2    |
| Normal                                        | 1050      | 86.8    |
| **Fasting Blood Sugar Levels**                |           |         |
| Risky                                         | 271       | 22.4    |
| Normal                                        | 939       | 77.6    |
| **Fasting Blood Sugar Levels Post-Loading**    |           |         |
| Risky                                         | 460       | 38.0    |
| Normal                                        | 750       | 62.0    |
| **Total Cholesterol Levels**                  |           |         |
| Risky                                         | 565       | 46.7    |
| Normal                                        | 645       | 53.3    |
| **Triglyceride Levels**                       |           |         |
| Risky                                         | 295       | 24.4    |
| Normal                                        | 915       | 75.6    |
| **LDL levels**                                |           |         |
| Risky                                         | 935       | 77.3    |
| Normal                                        | 275       | 22.7    |
Table 1 shows that the average age of respondents was 43.3 years. The majority of respondents were female (65.4%) with low level of education (60.7%) and income below the city minimum wage in Bogor City (95.4%). The majority of respondents had normal metabolic syndrome test results, only on systolic blood pressure measurements (59.1%) and diastolic (56.8%) with risky outcomes.

Table 2. Associated Risk Factors of Stroke

| Variable                          | Stroke |         | Not |         | P-Value | OR     | CI 95%         |
|-----------------------------------|--------|---------|-----|---------|---------|--------|---------------|
|                                  | n   | %      | n   | %      |         |        |               |
| Gender                           |      |        |     |        |         |        |               |
| Male                             | 18  | 4.30   | 401 | 95.70  | 0.670   | 1.139  | 0.627 – 2.068 |
| Female                           | 30  | 3.79   | 761 | 96.21  |         |        |               |
| Education                        |      |        |     |        |         |        |               |
| Low (Not School - Junior school) | 35  | 4.77   | 699 | 95.23  | 0.076   | 1.783  | 0.933 – 3.407 |
| High (high school - college)     | 13  | 2.73   | 463 | 97.27  |         |        |               |
| Type of work                     |      |        |     |        |         |        |               |
| Private employee/entrepreneur    | 46  | 3.89   | 1136| 96.11  | 0.384   | 0.526  | 0.121 – 2.285 |
| Civil Servants                   | 2   | 7.14   | 26  | 92.86  |         |        |               |
| Income                           |      |        |     |        |         |        |               |
| (City minimum wage = Rp 3,557,146) |      |        |     |        |         |        |               |
| < city minimum wage              | 45  | 3.90   | 1109| 96.10  | 0.585   | 0.717  | 0.216 – 2.382 |
| ≥ city minimum wage              | 3   | 5.36   | 53  | 94.64  |         |        |               |
| Ownership of Health Insurance    |      |        |     |        |         |        |               |
| It doesn't have                  | 15  | 3.54   | 409 | 96.46  | 0.574   | 0.837  | 0.449 – 1.559 |
| Have                             | 33  | 4.20   | 753 | 95.80  |         |        |               |
| Smoking Status                   |      |        |     |        |         |        |               |
| Smoke                            | 32  | 4.81   | 633 | 95.19  | 0.096   | 1.6771 | 0.907 – 3.080 |
| No smoking                       | 16  | 2.94   | 529 | 97.06  |         |        |               |
| Age to Start Smoking             |      |        |     |        |         |        |               |
| ≤ 15 years                       | 9   | 3.37   | 258 | 96.63  | 0.572   | 0.809  | 0.387 – 1.691 |
| > 15 years                       | 39  | 4.14   | 904 | 95.86  |         |        |               |
| Alcohol Consumption              |      |        |     |        |         |        |               |
| Yes                              | 13  | 5.10   | 242 | 94.90  | 0.298   | 1.412  | 0.736 – 2.711 |
| Not                              | 35  | 3.66   | 920 | 96.34  |         |        |               |
| Physical Activity                |      |        |     |        |         |        |               |
| Variable                              | Stroke                  | Not                     | P-Value | OR      | CI 95%     |
|--------------------------------------|-------------------------|-------------------------|---------|---------|------------|
|                                      | n  | %  | n  | %  |            |            |
| Heavy                               | 3  | 4.69 | 61 | 95.31 | 0.762 | 1.203 | 0.364 – 0.364 |
| Light                               | 45 | 3.93 | 1101 | 96.07 |        |        |            |
| Diabetes Mellitus                   |              |                          |        |         |            |            |
| Positive                            | 22 | 12.15 | 159 | 87.85 | 0.000 | 5.338 | 2.953 – 9.647 |
| Negative                            | 26 | 2.53 | 1003 | 97.47 |        |        |            |
| Emotional Mental Disorders          |              |                          |        |         |            |            |
| Annoyed                             | 6  | 3.75 | 154 | 96.25 | 0.880 | 0.935 | 0.391 – 2.236 |
| Usual                               | 42 | 4.00 | 1008 | 96.00 |        |        |            |
| Fasting Blood Sugar Levels          |              |                          |        |         |            |            |
| Risky                               | 19 | 7.01 | 252 | 92.99 | 0.004 | 2.366 | 1.305 – 4.290 |
| Usual                               | 29 | 3.09 | 910 | 96.91 |        |        |            |
| Fasting Blood Sugar Levels Post-Loading |        |                          |        |         |            |            |
| Risky                               | 23 | 5.00 | 437 | 95.00 | 0.149 | 1.526 | 0.856 – 2.722 |
| Usual                               | 25 | 3.33 | 725 | 96.67 |        |        |            |
| Total Cholesterol Levels            |              |                          |        |         |            |            |
| Risky                               | 31 | 5.49 | 534 | 94.51 | 0.011 | 2.145 | 1.174 – 3.918 |
| Usual                               | 17 | 2.64 | 628 | 97.36 |        |        |            |
| Triglyceride Levels                 |              |                          |        |         |            |            |
| Risky                               | 17 | 5.76 | 278 | 94.24 | 0.069 | 1.744 | 0.951 – 3.199 |
| Usual                               | 31 | 3.39 | 884 | 96.61 |        |        |            |
| LDL levels                          |              |                          |        |         |            |            |
| Risky                               | 42 | 4.49 | 893 | 95.51 | 0.084 | 2.109 | 0.887 – 5.014 |
| Usual                               | 6  | 2.18 | 269 | 97.82 |        |        |            |
| HDL levels                          |              |                          |        |         |            |            |
| Risky                               | 15 | 3.54 | 409 | 96.46 | 0.574 | 0.837 | 0.449 – 1.559 |
| Usual                               | 33 | 4.20 | 753 | 95.80 |        |        |            |
| Systolic Blood Pressure             |              |                          |        |         |            |            |
| Risky                               | 41 | 5.73 | 674 | 94.27 | 0.000 | 4.241 | 1.887 – 9.533 |
| Usual                               | 7  | 1.41 | 488 | 98.59 |        |        |            |
| Diastolic Blood Pressure            |              |                          |        |         |            |            |
| Risky                               | 36 | 5.24 | 651 | 94.76 | 0.009 | 2.355 | 1.213 – 4.572 |
| Usual                               | 12 | 2.29 | 511 | 97.71 |        |        |            |
| BMI                                 |              |                          |        |         |            |            |
| Obesity                             | 22 | 5.13 | 407 | 94.87 | 0.125 | 1.570 | 0.878 – 2.805 |
| Usual                               | 26 | 3.33 | 755 | 96.67 |        |        |            |

Source: Secondary Data of the NCD Risk Factor Cohort Study in Bogor City in 2017-2018 from the MoH RI

Table 2 shows the result of crosstabulation of stroke factors with the incidence of stroke that diabetes mellitus (p = 0.000; OR=5.338; CI 95%=2,953–9,647), systolic blood pressure (p=0.000; OR=4.214; CI 95%=1,887–9,533), total cholesterol (p=0.011; OR=2,145, CI 95%=1,174–3,918), diastolic blood pressure (p=0.009; OR=2,355; CI 95%=1,213–4,572), and fasting blood sugar levels (P=0.149; OR=1,526, CI 95%=0.856–2,722) is a variable related to stroke incidence in Bogor City in 2018.
Table 3. Logistic Regression Risk Factors of Stroke

| Risk Factors       | Model 1 P   | Model 1 AOR (95% C.I) | Model 2 P   | Model 2 AOR (95% C.I) | Model 3 P   | Model 3 AOR (95% C.I) | Model 4 P   | Model 4 AOR (95% C.I) |
|-------------------|-------------|-----------------------|-------------|-----------------------|-------------|-----------------------|-------------|-----------------------|
| Diabetes Mellitus | 0.000       | 0.249 (0.124-0.502)   | 0.000       | 0.237 (0.129-0.435)   | 0.000       | 0.238 (0.130-0.436)   | 0.000       | 0.222 (0.122-0.405)   |
| Systolic Blood Pressure | 0.333  | 0.333 (0.127-0.876)  | 0.025       | 0.331 (0.126-0.868)   | 0.005       | 0.308 (0.135-0.702)   | 0.003       | 0.291 (0.128-0.662)   |
| Total Cholesterol | 0.116       | 0.608 (0.327-1.131)   | 0.114       | 0.606 (0.326-1.127)   | 0.110       | 0.604 (0.325-1.122)   |            |                      |
| Diastolic Blood Pressure | 0.883 | 0.333 (0.197-1.62)   | 0.782       | 0.894 (0.404-1.978)   |            |                      |            |                      |
| Fasting Blood Sugar Levels | 0.774 | 0.901 (0.443-1.833)   |            |                      |            |                      |            |                      |

Constant | 0.000 | 117.326 | 0.000 | 115.277 | 0.000 | 112.855 | 0.000 | 90.648 | 0.000 |

Notes. Model 4: Hosmer and Lemeshow test: $\chi^2 = 38.281, P = 0.000$, Nagelkerke $R^2 = 11%$.
Source: Secondary Data of the NCD Risk Factor Cohort Study in Bogor City in 2017-2018 from the MoH RI

The results of the logistic regression test in table 4 showed that diabetes mellitus and systolic blood pressure were the main factors for stroke with p-value, AOR, and (95% C.I) respectively at 0.000, 0.222. (0.122-0.405), 0.003, 0.291 (0.128-0.662).

Table 4. Differences in Biomarkers of Metabolic Syndrome a Year Before Being Diagnosed with Stroke

| Biomarkers of Metabolic Syndrome | 2017 Mean; ± SD | 2018 Mean; ± SD | Z; p-value |
|----------------------------------|-----------------|-----------------|------------|
| Fasting blood sugar levels (mg/dL) | 101.13; ± 10:70 p.m. | 129.08; ± 68.52 | -2.163; 0.031 |
| Post-loading blood sugar levels (mg/dL) | 146.69; ± 67.98 | 183.08; ± 110.17 | -1.07; 0.285 |
| Total Cholesterol Levels (mg/dL) | 211.77; ± 37.22 | 216.88; ± 40.02 | -0.612; 0.541 |
| Triglyceride Levels (mg/dL) | 119.02; ± 61.25 | 159.21; ± 106.14 | -1.389; 0.165 |
| LDL (mg/dL) | 142.67; ± 32.74 | 138.58; ± 35.64 | -0.458; 0.647 |
| HDL (mg/dL) | 49.19; ± 11.95 | 49.83; ± 11.00 | -0.166; 0.869 |
| Systolic Blood Pressure (mmHg) | 157.31; ± 36.12 | 140.69; ± 10.15 p.m. | -1.487; 0.145 |
| Diastolic Blood Pressure (mmHg) | 95.19; ± 6.57 p.m. | 90.31; ± 13.78 | -0.608; 0.543 |
| IMT | 27.13; ± 4.09 | 27.42; ± 4.66 | -1.389; 0.165 |

Mann-Whitney Test
Source: Secondary Data of the NCD Risk Factor Cohort Study in Bogor City in 2017-2018 from the MoH RI

The average biomarker of metabolic syndrome a year before the diagnosis of stroke and the year when diagnosed with stroke showed results that did not differ significantly, only fasting blood sugar levels and systolic blood pressure, where fasting blood sugar levels in the year diagnosed stroke were higher than the year before the stroke was diagnosed, while the average systolic blood pressure in the year before diagnosis was higher, p-values 0.031, and 0.029, respectively.

The incidence of stroke during 2018 amounted to 48 cases (3.9%). Based on this study, the most vital risk factors for stroke in this population of diabetes mellitus and systolic blood pressure, especially in male patients with an average age of 43 years, a 2013 study in the same population showed that stroke was found at 49 (2. 6%) of the people from 1912 subjects studied (Riyadina & Rahajeng, 2013). It is a 1.3% increase over five years. While the incidence of stroke nationally in 2018 reached 10.9% (Badan Penelitian dan Pengembangan Kesehatan, 2018).

The proportion of strokes in this population was more common in men Zhang Y et al. (Y. Zhang et al., 2012). The incidence of Stroke in the United States, England, France,
Germany, Italy, and Spain increased with age, greater in men than women. Stroke is already present in the young age group of 15-24 years with a prevalence of 0.3% and 25 - 34 years by 0.4%, increasing sharply at 45 years and above. The National Health and Nutrition Examination Survey 2009-2012 in the United States found the prevalence of stroke in women ages 20-39 at 0.2% and men at 0.7% (Mozaffarian et al., 2015). Stroke was higher in groups with low education (not high school). It was closely related to less knowledge due to poor education, so less knowing the consequences of the improper lifestyle, such as eating high-fat and others will facilitate the onset of degenerative diseases (Meschia et al., 2014). It is necessary to counsel stroke prevention methods for a poorly educated specificity society. The appearance of stroke at a young age indicates that stroke prevention interventions should begin early.

The results show that DM was a significant factor in the occurrence of stroke, though statistically multivariate shows a negative direction, but some previous studies have proven a lot. DM increases the risk of stroke because excess glucose in the blood causes vasculopathy, making it more likely to develop hypertension and atherosclerosis. In addition, diabetes increases the risk of blood clots, which can lead to heart attacks and strokes (Azam et al., 2017; Sofiana et al., 2019). Excess sugar in the blood has a direct effect on the walls of blood vessels, binding to and changing the structure of proteins and molecules lining blood vessels, making it thicker, less elastic, and more likely to trigger thrombosis. Thicker, less elastic blood vessels mean that blood has a harder time flowing through narrower gaps and must do so at higher pressures. These changes cause tissue damage called final organ damage. A smaller space for blood to flow means a greater likelihood that clots can completely block blood vessels, causing a stroke or heart attack (Chaturvedi et al., 2020; Sofiana & Rahmawati, 2019; Sorgun et al., 2018). DM was a significant risk factor for cardiovascular disease, including stroke. It is also an independent risk factor in which 20% of diabetic patients will die from stroke (Lau et al., 2019; Mohiuddin, 2019; Shang et al., 2020).

Systolic blood pressure was shown to be a risk factor for stroke although an increase in systolic blood pressure had a higher effect on outcomes, both systolic and diastolic hypertension independently affected the risk of adverse cardiovascular events, regardless of the definition of hypertension ($\geq$120 mmHg and $\geq$80 mmHg (Flint et al., 2019), including Recurrent Stroke (Ovbiagele et al., 2011), and is the leading cause of cardiovascular death (Itoga et al., 2021; Paultre & Mosca, 2005). The association of hypertension with stroke has been widely explained by many studies. One study by O’Donnell et al. (2010), identified as many as 3,000 cases of stroke with the results of an OR analysis of 2.64. These results can be concluded that people diagnosed with hypertension have a risk of 2.64 times the incidence of stroke compared to people who are not diagnosed with hypertension (O’Donnell et al., 2010). Research by Chen et al. (2014), showed Asians were at 2.84 times the risk of having a stroke with hypertension as a risk factor (Chen et al., 2014). Another study by Zhang et al. (2004), also stated that hypertension is the most dominant risk factor that causes stroke incidence in Asians (X.-F. Zhang et al., 2004). The significant association between stroke and other hypertension in the Asian region is evidenced in a study conducted by Burke and Venketasubramanian (2006), with OR 9.03 (95% CI, 5.25–15.5) in Taiwan (Burke & Venketasubramanian, 2006). Research related to isolated systolic blood pressure in Indonesia said that the prevalence of stroke in ISH reached 8.3%. Women with smoking habits, experiencing mental and physical stress, urban living, and being poorly educated were associated with stroke status in ISH subjects in Indonesia (Pamelasari et al., 2021).

Stroke prevention strategies in this population should include early detection and immediate treatment. It is vital to control risk factors to reduce the burden of stroke. Both primary prevention and secondary prevention. Such as quitting smoking, doing exercise at least 150 minutes/week, a high-fiber diet, fruit and vegetable intake and low in sugar and salt, regulating weight, and pharmacotherapy to control hypertension and blood glucose. This research has some drawbacks. This study only covers one city area in West Java Province, so it has not been able to represent other regions.
with different characteristics; this study does not consider the subtypes of ischemic stroke, as well as several other risk factors such as other accompanying diseases not yet included. More research needs to be done to overcome these limitations. Hospital-based research on stroke and the risk factors associated with it should also be conducted in comparison to the results of this community-based study.

Conclusions

Strokes found in the community in the Kebon Kalapa village, Bogor City, based on the Study of NCD Risk Factors of the National Health Institute of Research and Development, MoH RI in 2018, amounted to 48 cases (3.9%). The main determinants of stroke in this population include diabetes mellitus and systolic blood pressure being the main factors for stroke, with each p-value, AOR, and (95% C.I.) being 0.000, 0.222 (0.122-0.405), 0.003, 0.291 (0.128-0.662). There was no significant difference in metabolic syndrome outcomes one year before the diagnosis of stroke and the year when the stroke was diagnosed. Special attention is needed in D.M. patients who have high blood pressure to prevent.

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