ORIGINAL ARTICLE

# Factors Associated with Hypertension-related Strokes at a Community Hospital in Southern Thailand

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**ABSTRACT**

**Introduction:** Stroke rates are increasing significantly worldwide. Comorbidity disease especially hypertension that an important modifiable risk factor for increasing the incidence of stroke and worsening outcomes. Furthermore, the burden of hypertension as a comorbidity of stroke in rural areas was limited, Therefore, the aim of this study was focus to evaluate factors associated with stroke patients having hypertension at Ratsada Hospital, Trang Province, southern Thailand. **Materials and methods:** A retrospective study was conducted by utilizing data from the January 1, 2018, to December 31, 2022 hospital database. Diagnoses of patients are identified by using ICD-10 (I60-I69), totaling, 333 patient records. The cumulative incidence rates of stroke with or without hypertension were calculated by using Logistic regression models to evaluate risk factors. **Results:** A total of 191 stroke patients with hypertension (57.36%); median [25$^{th}$-75$^{th}$ percentile] age 72 [61-80] years) and 142 stroke patients without hypertension (42.64%); median [25$^{th}$-75$^{th}$ percentile] age 61 [52-71] years. Factors associated with increased risk of stroke were age 60 years and above (AOR=2.66; CI:1.59-4.44; p<0.001), and high diastolic blood pressure (≥85 mmHg) (AOR=2.05; CI:1.19-3.53; p=0.010). In addition, glomerular filtration rate values of 60-89 ml/min/1.73 m$^2$ (AOR=1.95; CI:1.14-3.34; p=0.014) and 30-59 ml/min /1.73 m$^2$ (AOR=1.99; CI:1.02-3.89; p=0.043) were significant. **Conclusion:** This study found that age 60 and above, high diastolic blood pressure and specific glomerular filtration rate ranges were the potential risk factors of stroke with hypertension as a comorbidity disease. This finding suggests that providing intensive care for controlling and managing risk factors, especially in older adults.
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## INTRODUCTION

Stroke is a global problem. The report from the World Paralysis Organization indicated the global number of stroke patients in 2022 amounted to 12.2 million. New cases of stroke were identified every 3 seconds, resulting in a cumulative total of 101 million patients worldwide (1). This signifies a twofold increase in stroke cases over the last 30 years, highlighting it as a major global public health concern. In 2019, stroke held the position as the second most impactful cause of death (6.6 million people) and disability worldwide. Over the last three decades in absolute terms, the global incidence of stroke witnessed a 70% increase, with an 85% rise in its prevalence, a 43% increase in mortality, and a 32% increase in DALYs due to stroke (2).

Stroke results from the narrowing of the blood vessels in the brain or blood clots originating from other areas. These can block the cerebral arteries or cause ruptures, leading to high mortality and disability rates. Common outcomes include weakness, impaired vision, double vision, difficulty swallowing, speech issues, staggering gait, and dizziness (1,3). Major risk factors for stroke encompass high blood pressure, diabetes, elevated blood cholesterol, sleep apnea, and obesity, as well as lifestyle choices like smoking, alcohol consumption, and insufficient exercise. (4). Recognizing these factors is crucial for mitigating the risk of stroke. Worldwide, various studies have identified factors linked to stroke including age, sex, smoking, low physical activity, obesity, alcohol consumption, uncontrolled blood pressure, diabetes, and cholesterol levels. (5-11). Recognizing variations in significant risk factors observed across studies is essential.

In Thailand, the death rate among the Thai population due to stroke was a rising trend, reaching 53 per 100,000

population in 2020, the majority are individuals aged over 60, with a total of 23,817 people, accounting for 69% (12). While numerous studies have examined stroke risk factors, there is limited research on the specific factors associated with hypertension-related strokes in rural community hospital settings in Thailand. Additionally, the frequency of hospital admissions among stroke patients with hypertension has exhibited an increasing trend over time, and there is a limited availability of research findings aimed at exploring these factors. Hence, the objective of this study is to evaluate the factors associated with stroke patients who also have hypertension at Ratsada Hospital in Trang Province, southern Thailand.

## MATERIALS AND METHODS

### Study design and period

A retrospective study was conducted using the hospital database from January 1, 2018, to December 31, 2022.

### Population and sample

The patients are identified for stroke by using ICD-10 (I60-I69) and identified the comorbidity disease of hypertension with ICD-10 (I10). The sample included 191 stroke patients with hypertension and 142 stroke patients without hypertension, meeting the following inclusion criteria: aged 18 years and older, Thai nationality, and admitted to Ratsada Hospital, Trang Province, southern Thailand. The exclusion criteria were: not the responsibility of the Ratsada hospital, Trang province, southern Thailand, and the patient's medical record information is incomplete.

### Data collection procedure

The researcher obtained permission from the director of Ratsada Hospital in Trang Province to conduct the study. Subsequently, a group discussion was held to clarify the purpose and details of data collection, involving the researcher, computer technical officer, and medical statistics officers of Ratsada Hospital. Data were gathered from the Hosxp PCU database, the 43file database, and the hospital database. The collection period spanned five years, from January 1, 2018, to December 31, 2022.

### Assessment and definition of variables

Outcome variable: Stroke with hypertension
Independent variables.

General information: Sex, age (years), education level
Physical measurements and clinical factors: Systolic blood pressure (mmHg), diastolic blood pressure (mmHg), body mass index (BMI) (kg/m$^2$), cholesterol (mg/dL), high-density lipoprotein (HDL)(mg/dL), low-density lipoprotein (LDL) (mg/dL), fasting Blood Sugar (FBS) (mg/dL), glomerular filtration rate (eGFR) (ml/min/1.73 m$^2$).

Systolic blood pressure (mmHg): normal (<120), at-risk (prehypertension) (120-129), high blood pressure (hypertension) (≥130). Diastolic blood pressure (mmHg): normal (<80), at-risk (prehypertension) (80-84), high blood pressure (hypertension) (≥85). BMI: underweight (<18.50), normal (18.50-24.99), overweight (25-29.99), and obese (≥30). Cholesterol (mg/dL): desirable (<200), borderline high (200-239), high cholesterol level (≥240). HDL (mg/dL): low level (<40), normal (40-59), high level (≥60). LDL (mg/dL): optimal (<100), near or above optimal borderline high (100-129), borderline high (130-159), high level (160-189), very high level (≥ 190). FBS (mg/dL): normal (100-125), low level (<100), high level (>125). eGFR (ml/min/1.73 m$^2$): normal (≤90), mild loss (60-89), moderate to severe (30-59), severe loss = (15-29), failure (<15).

### Data analysis and management

The data underwent a process of cleaning, coding, entry, and analysis through the utilization of STATA program version 18. Summary statistics, including frequencies and tables, were utilized to present categorical variables, while the mean was employed for continuous variables in the sample.

### Statistical analysis

In the analysis using logistic regression, the dependent variable will be a dichotomous variable: 1 for stroke with hypertension and 0 for stroke without hypertension. Bivariate logistic regression was conducted to evaluate the association between independent and dependent variables. The multivariable logistic regression incorporated a variable with a P-value <0.05 significance level from bivariate logistic regression. Finally, multivariable logistic regression was employed to assess the association between independent variables and the dependent variable, as well as to control for confounding variables. Adjusted odds ratio, P-value < 0.05, and a 95% CI were utilized to determine statistical significance.

### Ethical Clearance

This research was undertaken after obtaining ethical approval from the Committee for the Ethical Review of Human Research at Thaksin University, No. TSU 2023_204. This research was conducted following ethical standards and the Helsinki Declaration of 1975, as revised in 2000.

## RESULTS

### Demographic characteristics of the sample

All 333 stroke patients in this study. A total of 191 stroke patients with hypertension (57.36%); median [25th-75th percentile] age 72 [61-80] years and 142 stroke patients without hypertension (42.64%); median [25th-75th percentile] age 61 [52-71] years. Over half of them were female and had an education level below

secondary education. Furthermore, the median [25th-75th percentile] of systolic blood pressure was 142 [130-164] mmHg., diastolic blood pressure (80 (70- 90) mmHg.), BMI (23.94 (21.23-26.93) kg/m ), cholesterol (194 (165-226) mg/dL.), HDL (49 (41-57) mg/dl.) LDL (116 (94-146) mg/dl.), FBS (107 (96-133) mg/dl.), eGFR (79.77 (61.51-95.18) ml/min/1.73 $m^2$ (Table I).

**Table I: Demographic characteristics of the sample (n=333)**

| General information | Stroke with hypertension (n=191) | Stroke without hypertension (n=142) | Total (n=333) |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| Sex | | | |
| Male | 68 (35.60) | 60 (42.25) | 128 (38.44) |
| Female | 123 (64.40) | 82 (57.75) | 205 (61.56) |
| Age (years) | | | |
| < 60 | 40 (20.94) | 60 (42.25) | 100 (30.03) |
| ≥ 60 | 151 (79.06) | 82 (57.75) | 233 (69.97) |
| Median ($P_{25}$ – $P_{75}$) | 72 (61-80) | 61 (52-71) | 66 (57-76) |
| Education level | | | |
| Upper secondary education | 72 (37.70) | 64 (45.07) | 136 (40.84) |
| Below secondary education | 79 (41.36) | 57 (40.14) | 136 (40.84) |
| Did not receive an education | 40 (20.94) | 21 (14.79) | 61 (18.32) |
| Systolic blood pressure (mmHg) | | | |
| < 120 | 13 (6.81) | 19 (13.38) | 32 (9.61) |
| 120 – 129 | 15 (7.85) | 20 (14.08) | 35 (10.51) |
| ≥ 130 | 163 (85.34) | 103 (72.54) | 266 (79.88) |
| Median ($P_{25}$ – $P_{75}$) | 150 (130-163) | 140 (126-154) | 142 (130-164) |
| Diastolic blood pressure (mmHg) | | | |
| < 80 | 69 (36.13) | 59 (41.55) | 128 (38.44) |
| 80 – 84 | 36 (18.85) | 44 (30.99) | 80 (24.02) |
| ≥ 85 | 86 (45.03) | 39 (27.46) | 125 (37.54) |
| Median ($P_{25}$ – $P_{75}$) | 80 (71-93) | 80 (70-87) | 80 (70- 90) |
| Body mass index (BMI) (kg/m ) | | | |
| < 18.50 | 13 (6.81) | 11 (7.75) | 24 (7.21) |
| 18.50 – 24.99 | 99 (51.83) | 80 (56.34) | 179 (53.75) |
| 25.0 - 29.99 | 56 (29.32) | 34 (23.94) | 90 (27.03) |
| ≥ 30.00 | 23 (12.04) | 17 (11.97) | 40 (12.01) |
| Median ($P_{25}$ – $P_{75}$) | 23.83 (21.3-27.05) | 23.98 (21.22-26.64) | 23.94 (21.23-26.93) |
| Cholesterol (mg/dL) | | | |
| < 200 | 109 (57.07) | 73 (51.41) | 182 (54.65) |
| 200 - 239 | 46 (24.08) | 43 (30.28) | 89 (26.73) |
| ≥ 240 | 36 (18.85) | 26 (18.31) | 62 (18.62) |
| Median ($P_{25}$ – $P_{75}$) | 192 (162-226) | 198 (170-227) | 194 (165-226) |
| High-density lipoprotein (HDL) (mg/dL) | | | |
| 40 - 59 | 118 (61.78) | 77 (54.23) | 195 (58.56) |
| < 40 | 39 (20.42) | 34 (23.94) | 73 (21.92) |
| ≥ 60 | 34 (17.80) | 31 (21.83) | 65 (19.52) |
| Median ($P_{25}$ – $P_{75}$) | 50 (41-56) | 49 (41-58) | 49 (41-57) |
| Low-density lipoprotein (LDL) (mg/dL) | | | |
| < 100 | 60 (31.41) | 41 (28.87) | 101 (30.33) |
| 100 – 129 | 67 (35.08) | 45 (31.69) | 112 (33.63) |
| 130 – 159 | 36 (18.85) | 30 (21.13) | 66 (19.82) |
| 160 – 189 | 16 (8.38) | 11 (7.75) | 27 (8.11) |
| ≥ 190 | 12 (6.28) | 15 (10.56) | 27 (8.11) |
| Median ($P_{25}$ – $P_{75}$) | 114 (91-143) | 119.5 (98-151) | 116 (94-146) |
| Fasting Blood Sugar (FBS) (mg/dL) | | | |
| 100 – 125 | 59 (30.89) | 48 (33.80) | 107 (32.13) |
| < 100 | 72 (37.70) | 51 (35.92) | 123 (36.94) |
| > 125 | 60 (31.41) | 43 (30.28) | 103 (30.93) |
| Median ($P_{25}$ – $P_{75}$) | 106 (95-133) | 107 (96-136) | 107 (96-133) |
| Glomerular filtration rate (eGFR) (ml/min/1.73 $m^2$) | | | |
| ≥ 90 | 45 (23.56) | 59 (41.55) | 104 (31.23) |
| 60 - 89 | 96 (50.26) | 55 (38.73) | 151 (45.35) |
| 45 - 59 | 31 (16.23) | 19 (13.38) | 50 (15.02) |
| 30 - 44 | 13 (6.81) | 4 (2.82) | 17 (5.11) |
| 15 – 29 | 4 (2.09) | 5 (3.52) | 9 (2.70) |
| < 15 | 2 (1.05) | 0 (0.00) | 2 (0.60) |
| Median ($P_{25}$ – $P_{75}$) | 76.07 (59.29-89.59) | 82.61 (63.78-98.79) | 79.77 (61.51-95.18) |

CONTINUE

## Factors associated with hypertension-related strokes

Bivariate logistic regression was conducted to explore factors associated with stroke patients with hypertension. The outcome of the bivariate logistic regression indicates an association with individuals aged over 60 years (COR=2.76; CI:1.71-4.47), systolic blood pressure level is higher than normal (≥130mmHg) (COR=2.31; CI:1.10-4.88), diastolic blood pressure level is higher than normal (≥85mmHg) (COR=1.89; CI:1.13-3.15), eGFR with a value of 60-89 ml/min/1.73 $m^2$ (COR=2.29; CI:1.37-3.81), and eGFR values were 30-59 ml/min/1.73 $m^2$ (COR=2.51; CI:1.33-4.74), were found to be significant predictors (Table II).

**Table II: Bivariate logistic regression was conducted to explore factors associated with stroke patients with hypertension. (n=333)**

| Variables | Stroke with hypertension | Stroke without hypertension | COR | p-value | 95%CI |
|---|---|---|---|---|---|
| | n (%) | n (%) | | | |
| Sex | | | | | |
| Male | 68 (35.60) | 60 (42.25) | Ref. | | |
| Female | 123 (64.40) | 82 (57.75) | 1.32 | 0.218 | 0.85 - 2.07 |
| Age (years) | | | | | |
| < 60 | 40 (20.94) | 60 (42.25) | Ref. | | |
| ≥ 60 | 151 (79.06) | 82 (57.75) | 2.76 | < 0.001* | 1.71 - 4.47 |
| Education level | | | | | |
| Upper secondary education | 72 (37.70) | 64 (45.07) | Ref. | | |

CONTINUE

**Table II: Bivariate logistic regression was conducted to explore factors associated with stroke patients with hypertension. (n=333). (CONT.)**

| Variables | Stroke with hypertension | Stroke without hypertension | COR | p-value | 95%CI |
|---|---|---|---|---|---|
| | n (%) | n (%) | | | |
| Education level | | | | | |
| Below secondary education | 79 (41.36) | 57 (40.14) | 1.23 | 0.393 | 0.76 -1.99 |
| Did not receive an education | 40 (20.94) | 21 (14.79) | 1.69 | 0.099 | 0.91 - 3.17 |
| Systolic blood pressure (mmHg) | | | | | |
| < 120 | 13 (6.81) | 19 (13.38) | Ref. | | |
| 120 – 129 | 15 (7.85) | 20 (14.08) | 1.09 | 0.853 | 0.41 - 2.90 |
| ≥ 130 | 163 (85.34) | 103 (72.54) | 2.31 | 0.028* | 1.10 - 4.88 |
| Diastolic blood pressure (mmHg) | | | | | |
| < 80 | 69 (36.13) | 59 (41.55) | Ref. | | |
| 80 – 84 | 36 (18.85) | 44 (30.99) | 0.70 | 0.212 | 0.40 - 1.23 |
| ≥ 85 | 86 (45.03) | 39 (27.46) | 1.89 | 0.016* | 1.13 - 3.15 |
| Body mass index (BMI) (kg/m²) | | | | | |
| < 18.50 | 13 (6.81) | 11 (7.75) | Ref. | | |
| 18.50 – 24.99 | 99 (51.83) | 80 (56.34) | 1.05 | 0.916 | 0.45 - 2.46 |
| 25.0 - 29.99 | 56 (29.32) | 34 (23.94) | 1.39 | 0.474 | 0.56 - 3.46 |
| ≥ 30.00 | 23 (12.04) | 17 (11.97) | 1.14 | 0.795 | 0.41 - 3.17 |
| Cholesterol (mg/dL) | | | | | |
| < 200 | 109 (57.07) | 73 (51.41) | Ref. | | |
| 200 - 239 | 46 (24.08) | 43 (30.28) | 0.72 | 0.201 | 0.43 - 1.19 |
| ≥ 240 | 36 (18.85) | 26 (18.31) | 0.93 | 0.800 | 0.52 - 1.66 |
| High-density lipoprotein (HDL) (mg/dL) | | | | | |
| 40 - 59 | 118 (61.78) | 77 (54.23) | Ref. | | |
| < 40 | 39 (20.42) | 34 (23.94) | 0.75 | 0.295 | 0.44 - 1.29 |
| ≥ 60 | 34 (17.80) | 31 (21.83) | 0.72 | 0.246 | 0.41 - 1.26 |
| Low-density lipoprotein (LDL) (mg/dL) | | | | | |
| < 100 | 60 (31.41) | 41 (28.87) | Ref. | | |
| 100 – 129 | 67 (35.08) | 45 (31.69) | 1.02 | 0.951 | 0.59 - 1.76 |
| 130 – 159 | 36 (18.85) | 30 (21.13) | 0.82 | 0.535 | 0.44 - 1.53 |
| 160 – 189 | 16 (8.38) | 11 (7.75) | 0.99 | 0.989 | 0.42 - 2.36 |
| ≥ 190 | 12 (6.28) | 15 (10.56) | 0.55 | 0.167 | 0.23 - 1.29 |
| Fasting Blood Sugar (FBS) (mg/dl) | | | | | |
| 100 – 125 | 59 (30.89) | 48 (33.80) | Ref. | | |
| < 100 | 72 (37.70) | 51 (35.92) | 1.15 | 0.604 | 0.68 - 1.94 |
| > 125 | 60 (31.41) | 43 (30.28) | 1.14 | 0.649 | 0.66 - 1.96 |
| Glomerular filtration rate (eGFR) (ml/min/1.73 m²) | | | | | |
| ≥ 90 | 45 (23.56) | 59 (41.55) | Ref. | | |
| 60 - 89 | 96 (50.26) | 55 (38.73) | 2.29 | 0.001* | 1.37 - 3.81 |
| 30 - 59 | 44 (23.04) | 23 (16.20) | 2.51 | 0.005* | 1.33 - 4.74 |
| < 29 | 6 (3.14) | 5 (3.52) | 1.57 | 0.477 | 0.45 - 5.48 |

* Level of significance at p < 0.05

## Multivariable logistic regression was conducted to explore factors associated with stroke patients with hypertension

Multivariable logistic regression for individuals aged over 60 years (AOR=2.66; CI:1.59-4.44), lower blood pressure level that is higher than normal (≥85 mmHg) (AOR=2.05; CI:1.19-3.53), eGFR 60-89 ml/min/1.73 m² (AOR=1.95; CI:1.14-3.34), eGFR 30-59 ml/min/1.73 m² (AOR=1.99; CI:1.02-3.89) (Table III).

**Table III: Multivariable logistic regression was conducted to explore factors associated with stroke patients with hypertension. (n=333)**

| Variables | Stroke with hypertension | Stroke without hypertension | COR | AOR | p-value | 95%CI |
|---|---|---|---|---|---|---|
| | n (%) | n (%) | | | | |
| Age (years) | | | | | | |
| < 60 | 40 (20.94) | 60 (42.25) | Ref. | | | |
| ≥ 60 | 151 (79.06) | 82 (57.75) | 2.76 | 2.66 | < 0.001* | 1.59 - 4.44 |
| Diastolic blood pressure (mmHg) | | | | | | |
| < 80 | 69 (36.13) | 59 (41.55) | Ref. | | | |
| 80 – 84 | 36 (18.85) | 44 (30.99) | 0.70 | 0.74 | 0.315 | 0.41 - 1.33 |
| ≥ 85 | 86 (45.03) | 39 (27.46) | 1.89 | 2.05 | 0.010* | 1.19 - 3.53 |
| Glomerular filtration rate (eGFR) (ml/min/1.73 m²) | | | | | | |
| ≥ 90 | 45 (23.56) | 59 (41.55) | Ref. | | | |

CONTINUE

**Table III: Multivariable logistic regression was conducted to explore factors associated with stroke patients with hypertension. (n=333) (CONT.)**

| Variables | Stroke with hypertension | Stroke without hypertension | COR | AOR | p-value | 95%CI |
|---|---|---|---|---|---|---|
| | n (%) | n (%) | | | | |
| Glomerular filtration rate (eGFR) (ml/min/1.73 $m^2$) | | | | | | |
| 60 - 89 | 96 (50.26) | 55 (38.73) | 2.29 | 1.95 | 0.014* | 1.14 - 3.34 |
| 30 - 59 | 44 (23.04) | 23 (16.20) | 2.51 | 1.99 | 0.043* | 1.02 - 3.89 |
| < 29 | 6 (3.14) | 5 (3.52) | 1.57 | 1.28 | 0.703 | 0.36 - 4.61 |

* Level of significance at p < 0.05

## DISCUSSION

To our knowledge, this is the first study to examine factors associated with hypertension-related strokes in a rural Thai community hospital setting. Our findings extend previous research by the prevalence of stroke among the Thai population was a dramatically rising trend. Furthermore, comorbidities, especially hypertension, are important modifiable risk factors contributing to the increased incidence of stroke and worsened outcomes. In this retrospective study spanning 5 years, hospital databases were utilized to assess factors associated with stroke patients with or without hypertension at Ratsada Hospital in Trang Province, southern Thailand. The results indicated that significant factors for stroke patients, whether with or without hypertension, included age over 60 years, high diastolic blood pressure level (≥85 mmHg), and glomerular filtration rate (eGFR) between 30-89 and 60-89 ml/min/1.73 $m^2$

Stroke patients who are over 60 years of age have a chance of higher risk of stroke with high blood pressure than patients who are less than 60 years of age were 2.66 (AOR=2.66; CI:1.59-4.44). Age is the most robust non-modifiable risk factor for incident stroke. Approximately three-quarters of all strokes occur in individuals aged 65 years and older, and this trend is increasing (13). The incidence and prevalence of hypertension and cerebrovascular disease were raised dramatically with age due to alterations in vascular function (14). The alterations in arteries linked to aging encompass reduced collagen content, heightened intima-media thickness, and increased apoptosis of vascular smooth muscle cells (16). These changes may interfere with hemodynamic processes that increase older adults at risk of stroke. According to the study of Chutarat Sathirapanya et al. (15), which found that as age increases, the incidence of stroke will increase. It also demonstrated that for people who are older or equal to 55 years of age, the risk is 2.94 times greater than that of people younger than 55 years of age, and it is mostly found between the ages of 55-85 years (15). Furthermore, mortality associated with stroke increases with age. Mortality rates from stroke in the entire population are likely to rise in individuals aged 65 years and older (17).

Blood pressure levels (≥85mmHg) were at higher risk of stroke with high blood pressure than patients with blood pressure values in optimal levels (<80mmHg) 2.05 times (AOR=2.05; CI:1.19-3.53). Similar to Harmsen et al. study (18), found that the most important factor associated with stroke, especially Systolic BP values of 160 mmHg or more and Diastolic BP of 85 mmHg or more (p<0.05) (18). Similar to Paolo Verdecchia et al (19), the study revealed that heightened blood pressure may induce turbulence, particularly at bifurcation points. This process precipitates the formation of fresh thrombi and advances dislodged emboli into areas with narrowed vessels, compromising perfusion and elevating the risk of infarcts in older adults (19). Hypertension promotes the formation of atherosclerotic plaques in cerebral arteries and arterioles (20). The consequence of high blood pressure leads to blockage or narrowing of blood vascular which may be a consequence of high blood pressure causing damage to the arterial walls. If the arteries are very narrow, it may result in a lack of blood supply to that area of the brain, causing damage or death of brain tissue, and causing the brain to lose control of the organs in the body (21). Furthermore, hypertension induces fibrinoid necrosis (lipo hyalinosis) in penetrating arteries and arterioles that supply the white matter, leading to small white matter infarcts (lacunes) or brain hemorrhage (22). Symptoms depend on the location of the lack of blood supply. The severity depends on the damage to the brain tissue (21). Therefore, it can be seen that increased blood pressure levels increase the chance of having a stroke than people with low blood pressure levels (23).

In addition, the significant factor for stroke patients with/without hypertension was eGFR with value of 60-89 ml/min/1.73 $m^2$ and value of 30-59 ml/min/1.73 $m^2$. These values of eGFR have an increased chance of patients developing a risk of stroke than patients with a normal eGFR (≤90 ml/min/1.73 $m^2$) was 1.95 times (AOR=1.95; CI:1.14-3.34) and 1.99 times (AOR=1.99; CI:1.02-3.89), respectively. Renal dysfunction has been recognized as a novel risk factor influencing stroke prognosis, with eGFR being one of the parameters used as its proxy (24), leading to an increased concentration of asymmetric dimethylarginine, which inhibits the generation of nitric oxide. Simultaneously, it induces low-grade inflammation, elevates oxidative stress, causes dyslipidemia, and enhances the activity of the renin-angiotensin system, ultimately stimulating the production of superoxide and cytokines (25-27). According to Pitsanuporn Saicamthon et al., that found patients who had a history of kidney disease were at higher risk of stroke 14.86 times than patients who had no history of kidney disease (p<0.001) (28). Furthermore, the study of Meng Lee et al. (29), they found Incident stroke risk increased among participants with an eGFR

<60 ml/min/1.73 $m^2$ (relative risk 1.43, 95% CI 1.31 to 1.57; P<0.001) (29). The influence of low eGFR on stroke disability was also observed in ischemic stroke patients with atrial fibrillation (30).

Our study has limitations. Approximately one-quarter of stroke patients admitted to hospital were excluded due to missing data and incomplete lab results from the hospital database, which might cause selection bias.

## CONCLUSION

Among those aged over 60 years and above, high diastolic blood pressure level (≥85mmHg), eGFR with a value of 60-89 ml/min/1.73 $m^2$, and with a value of 30-59 ml/min /1.73$m^2$ were associated with stroke with hypertension. Hence, implementing additional intervention and prevention mechanisms is crucial for enhancing primary stroke prevention in individuals with hypertension.

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