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Epidemiological Study of Stroke Disease in the Southeast Maluku Islands Region in 2023

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ABSTRACT

Introduction: Stroke is a serious health problem with a high mortality rate and incidence, especially in low- and middle-income regions like Southeast Maluku, Indonesia. Inadequate facilities and risk factors causing high stroke rates in this region provide major healthcare challenges. Epidemiological data highlight the pressing need for healthcare development. **Objective:** This epidemiological study aimed to provide insight on the prevalence of stroke in the Southeast Maluku Islands in 2023, with the goal of enhancing the urgency of measures to reduce stroke incidences there. **Methods:** This study used a descriptive methodology with a cross-sectional design. Data were collected by obtaining thorough medical records from stroke patients at Karel Sadsuitubun Regional General Hospital. Demographic information, stroke type, and comorbidities were analyzed, as well as the prevalence rate calculated from the entire patient population of 8,436 as reported in 2023, while also classifying patients by age and gender. **Results:** In the Southeast Maluku Islands, 107 stroke cases were reported, equal to a stroke prevalence rate of 12.6 per 1,000 people. The most common type was ischemic stroke (95.33%), followed by hemorrhagic stroke (4.67%). Hypertension, which affected 67.2% of patients, was the most common comorbidity, followed by type II diabetes mellitus and coronary artery disease. **Conclusion:** Stroke rates have increased in the Southeast Maluku Islands due to a variety of factors, including socioeconomic conditions and unhealthy lifestyles. The study's findings emphasize the urgent need for interventions to reduce stroke rates.

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INTRODUCTION

Stroke is a disease with a high mortality rate.¹ The World Health Organization reports that the incidence of stroke increased by 70% between 1990 and 2019, with a 43% increase in stroke-related death.² Ischemic stroke is the most prevalent type, accounting for 62.4% of all global stroke cases reported in 2019, and it is expected to increase across all genders, age groups, and socio-demographic quintiles in various countries between 2020 and 2030.^{3,4} On the other hand, hemorrhagic stroke makes up just 10% to 20% of all stroke cases annually. Hemorrhagic strokes are relatively common in several countries, ranging from 8–15% in the United States, the United Kingdom, and Australia, and 18–24% in Japan and Korea.^{5,6,7} Its annual incidence is between 12% and 15% per 100,000 people. Certain low- and middle-income countries, particularly in Africa and Asia, have also reported high incidence rates. This disease affects more men than women and worsens with age.⁸ Early stroke diagnosis is critical to minimizing death. Delays in treatment can lead to secondary damage, resulting in permanent brain tissue injury.^{9,10} The limited treatment window for stroke poses a significant challenge.^{11,12,13} Thus, effective and efficient treatment necessitates adequate diagnostic support and management resources.¹⁴ This presents a considerable difficulty in remote areas, particularly islands, because the establishment of critical healthcare facilities for stroke management is not given high priority.¹⁵

Southeast Maluku, commonly known as the Kei Islands, is a rural region in Indonesia covering 1,031.81 km².¹⁶ This region exhibits the highest prevalence of hypertension within Maluku Province, with a reported rate of 38.23%, as documented in the Regional Health Report of Maluku Province.¹⁷ Socioeconomic status and poor lifestyle, such as smoking and alcohol consumption, are significant contributors to this disease. In 2024, Southeast Maluku had a poverty rate of 21.22%.¹⁸ Although this rate is not the highest in the Maluku region, it still stands out as significantly high when compared to other provinces. Maluku has a high smoking prevalence of 28.04% and the lowest smoking cessation rate in Indonesia, at only 6.5%.^{19,20} Maluku is also one of the six provinces with the highest alcohol consumption rates, with estimates ranging from 10 to 19.9%.²¹ These factors combine to worsen the burden of chronic diseases, contributing to the rising incidence of stroke.

The poor healthcare facilities and multiple risk factors in the population lead to a high prevalence of several diseases, especially stroke. This situation underlines the urgent necessity to enhance healthcare development in Southeast Maluku, despite the lack of supporting epidemiological data. We can address this urgency by conducting a stroke epidemiological study.

The data derived from this study could establish a basis for developing and executing government policies concerning stroke and, crucially, facilitate the progression of future research. This study will focus on the prevalence of stroke in the Southeast Maluku Islands in 2023. This study is projected to have a favorable impact on the advancement of medical knowledge in Southeast Maluku, notably in neurology, as well as increase policymakers' urgency to address stroke management.

OBJECTIVE

The purpose of this study was to determine the prevalence of stroke in the Southeast Maluku Islands for the year 2023, as well as the percentage of chronic diseases associated with stroke, as these could be significant risk factors.

METHODS

This study employed a descriptive design with a cross-sectional methodology. From February to March 2024, data will be gathered by looking through the medical records of stroke patients at Southeast Maluku's main referral center, Karel Sadsuitubun General Hospital. The Hospital Ethics Committee approved this study with the approval letter number 411.6/RSU-KS/IV/2023.

The study will include patients diagnosed with stroke by neurologists in 2023. We collected patient demographic data, which included age, gender, stroke type, and the presence of comorbid chronic conditions. The prevalence rate of stroke was calculated by dividing the total number of stroke patients by the total number treated at Karel Sadsuitubun General Hospital in 2023, which was 8,436. This institution serves as a representative healthcare provider for the Southeast Maluku region. The study analyzed the percentage of stroke patients by age group (20-44 years, 45-64 years, and ≥ 65 years), gender, stroke type, and associated chronic conditions. We also used the Chi-square test to assess the association between stroke type (ischemic and hemorrhagic stroke) and relevant variables. A *p*-value of < 0.05 was considered statistically significant. The analysis was conducted using IBM SPSS Statistics, version 22.0.

RESULTS

In 2023, Karel Sadsuitubun General Hospital diagnosed 107 patients with stroke. The prevalence of stroke patients was determined by dividing the number of stroke patients by the total number of patients

treated at Karel Sadsuitubun General Hospital in 2023, which amounted to 8,436 patients. This calculation resulted in a prevalence rate of 12.6 per 1,000 people. The percentage of hemorrhagic stroke cases was 4.67%, while ischemic stroke cases accounted for 95.33% (Table 1).

Table 1. Stroke type at Karel Sadsuitubun General Hospital in 2023

Stroke Type	n
Ischemic stroke	102 (95.33%)
Hemorrhagic stroke	5 (4.67%)

According to the demographic analysis, there were 53 (51.9%) males and 49 (48.1%) females with ischemic stroke, while 3 (60%) of those with hemorrhagic stroke were males and 2 (40%) were females. There was no statistically significant association between gender and stroke type ($p = 0.725$) (Table 2). The mean ages for ischemic and hemorrhagic strokes were 57.3 ± 9.3 and 57 ± 7.7 , respectively, with no significant correlation between ages and stroke types ($p = 0.343$). The age distribution of ischemic stroke patients revealed that 8 (7.8%) belonged to the 20–44 age group, 71 (69.6%) to the 45–64 age group, and 23 (22.5%) to the ≥ 65 age group. Four patients (80%) with hemorrhagic stroke were between 45 and 64, and one patient (20%) was ≥ 65 years old. Age stratification and stroke type did not show a statistically significant association (Table 2).

Table 2. Characteristics data of stroke patients at Karel Sadsuitubun General Hospital in 2023

Variable	Ischemic Stroke	Hemorrhagic Stroke	P-value
Sex (n)			0.725
- Male	53 (51.9%)	3 (60%)	-
- Female	49 (48.1%)	2 (40%)	-
Ages (mean \pm SD)	57.3 ± 9.3	57 ± 7.7	0.343
- 20-44 (n)	8 (7.8%)	-	0.634
- 45-64 (n)	72 (70.6%)	3 (60%)	0.123
- ≥ 65 (n)	22 (21.6%)	2 (40%)	0.696

The most common comorbidity among the 107 stroke patients treated at Karel Sadsuitubun was hypertension, which affected 67.2% of them ($n = 71$). Of those who suffered an ischemic stroke, 20.5% had stage 1 hypertension and 44.1% had stage 2 hypertension. Notably, all patients with hemorrhagic stroke had stage 2 hypertension. Type II diabetes mellitus was the second most frequent chronic condition, with 12 patients (11.7%), followed by coronary artery disease, which was seen in 11 patients (10.7%). Only ischemic stroke patients saw both

conditions. However, there were no statistically significant associations between these chronic diseases and stroke types (Table 3).

Table 3. Chronic diseases among stroke patients at Karel Sadsuitubun General Hospital in 2023

Chronic Disease	Ischemic Stroke	Hemorrhagic Stroke	P-value
Hypertension			0.258
- Stage 1	21(20.5%)	-	-
- Stage 2	45(44.1%)	5 (100%)	-
Type II Diabetes Mellitus	12(11.7%)	-	0.416
Cardiovascular disease	11(10.7%)	-	0.438

DISCUSSION

This study found that the stroke prevalence rate in Southeast Maluku Island was 12.6 per 1,000 population. This rate significantly exceeds the national prevalence rate of 10.9 per 1,000 population, as reported by Indonesia Basic Health Research 2013.²² According to a study by Howard *et al.*, which more widely compared rural to urban stroke risk, the Southeast Maluku Islands in Indonesia are linked with a 23–30% higher risk.²³ Socioeconomic factors and restricted access to healthcare contributed to this elevated risk. This island is served by only two, both of which are located on Kei Kecil Island, and neither has enough diagnostic facilities nor specialist healthcare professionals. This region ranks as the fifth poorest district in the Maluku Province, with a poverty rate of 21.22% and a population primarily from low-income backgrounds.¹⁸ Chronic diseases, as risk factors, significantly influence stroke. Low socioeconomic status correlates with psychosocial stress, which increases the risk of chronic disease.^{24,25}

The REGARDS (Reasons for Geographic and Racial Differences in Stroke) study found that chronic diseases like hypertension, diabetes, and cardiovascular diseases were more prevalent in rural areas. The odds ratios for each condition were 1.25, 1.15, and 1.19, respectively.²⁶ Southeast Maluku District has the highest rate of hypertension in Maluku Province, at 38.23%.¹⁷ Several risk factors, such as the residents' lifestyle and habits, contribute to this prevalence. BPS reported that 28.04% of the Maluku Province's population in 2023 were smokers.¹⁹ Furthermore, Maluku Province has one of the highest alcohol consumption rates in Indonesia, at 11.05%.¹⁷ Recent studies have found a significant correlation between "sopi," a traditional Maluku alcoholic beverage, and an increased risk of stroke, specifically hypertension and cardiovascular disease.²⁷ In contrast, stroke prevalence has been reported to be lower in

regions with lower alcohol consumption rates, particularly in western Indonesia, including Java, Sumatra, and Kalimantan.²⁸

Dietary habits are another factor that contribute to the high prevalence of hypertension. In Southeast Maluku, “*Sir-sir*,” a traditional dish made from cassava leaves, is frequently eaten. Certain studies have found that eating it may elevate blood pressure because it contains a lot of essential minerals like sodium and potassium, which contributes to an increased risk of stroke.²⁹ The local habit of consuming salted fish adds to the increasing prevalence of hypertension.³⁰ Tanimbar Island, which is a part of Southeast Maluku, has a high prevalence of hypertension, according to recent studies. Although the Tanimbarese are the most common ethnic group on the island and in Southeast Maluku, no research has looked specifically at the association between this ethnicity and stroke comorbidities.³¹ According to this study’s results, ischemic strokes were more common than hemorrhagic ones (95.33% vs. 4.67%). Another study in Indonesia found similar results, with 67.1% of strokes being ischemic and 29.6% being hemorrhagic.³²

Globally, strokes are more common in females than in males, with rates of 25.1% and 24.7%, respectively. The data are consistent with the study’s findings, which showed a higher proportion of males compared to females. Females exhibit a higher incidence of intracranial aneurysm stroke and subarachnoid hemorrhage, whereas males have a higher incidence of hemorrhagic stroke.^{33,34,35} However, studies on the prevalence of stroke in Southeast Asia reveal varying statistics. Males have greater stroke incidence and mortality rates than females, with these rates increasing with age, according to a study by Hwong *et al.* that included samples from 11 Southeast Asian countries, including Indonesia.³⁶ Various factors, particularly the higher prevalence of risk factors like smoking among males, are responsible for this discrepancy. Markidan *et al.* reported an odds ratio of 1.88 (95% CI, 1.44-2.44) for stroke in smokers compared to non-smokers.³⁷ The high percentage of smokers in Maluku Province further supports this finding.¹⁹ In addition to gender, age groups also show differences in stroke incidence, with the risk increasing with age; approximately 50% of stroke cases occur in individuals over 75 years old.^{38,39}

This study also found that 62.6% of stroke patients had hypertension. Li *et al.* did a study in China and found that among 168,417 patients with hypertension, 11,143 had a history of stroke, resulting in an incidence rate of 6.62% and a stroke risk of 78.9%.⁴⁰ Hypertension is a key risk factor for stroke, with a high global incidence, especially in Asia.⁴¹ Furthermore, the incidence rate rises with the severity

of hypertension. Gao *et al.* reported that the prevalence of stroke is higher in stage 2 hypertension than in stage 1 for both ischemic and hemorrhagic strokes (26.3% vs. 17%).⁴² Further modifiable risk factors for stroke after hypertension are diabetes mellitus and cardiovascular disease.⁴³ In line with this study, diabetes mellitus and cardiovascular disease were the next two highest risk factors for stroke. According to Lau *et al.*, the prevalence of stroke associated with diabetes mellitus was 28% (95% CI, 26-31%), with ischemic and hemorrhagic stroke prevalence rates of 33% and 24%, respectively.⁴⁴ Diabetes mellitus also increases the risk of recurrent ischemic stroke, with a hazard ratio of 1.50.⁴⁵ Furthermore, cardiovascular disease significantly contributes to stroke risk, with one-third of stroke patients having a history of cardiovascular disease, where atrial fibrillation and flutter are primary risk factors.⁴⁶ Frerich *et al.* found a genetic predisposition to atrial fibrillation and coronary artery disease associated with stroke susceptibility.⁴⁷

The first epidemiological study of stroke in Southeast Maluku is presented here. Apart from analyzing the prevalence of stroke, the study provides of several demographic and clinical characteristics, including gender, age, and related chronic diseases, thereby offering valuable data for further investigations. However, due to the lack of additional radiological examinations, this study’s stroke type diagnosis and categorization can only be conducted clinically by a neurologist.

CONCLUSION

This stroke epidemiological study found that the Southeast Maluku Islands have a higher stroke prevalence rate than both the national and regional averages in Indonesia. This high rate is caused by many things, such as low socioeconomic status, limited access to healthcare, unhealthy lifestyle and behavioral habits, and a high prevalence of chronic diseases such as hypertension, diabetes mellitus, and cardiovascular disease, all of which enhance the risk of stroke. The results demonstrate the importance of stroke prevention. Implementing these strategies is likely to improve healthcare services in Southeast Maluku, which will be beneficial for the community’s general health and well-being.

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Conflict of Interest

No conflict of interest was declared by the authors.

Ethic Consideration

The Karel Sadsuitubun General Hospital Ethics Committee approved this study under the approval letter number: 411.6/RSU-KS/IV/2023.

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Author Contributions

FPP, FXR, and JPN contributed to study design, manuscript drafting, collecting data, and manuscript writing. YPS supervised and reviewed the manuscript.

REFERENCES

- Vahdati SS. Factors affecting complications and mortality of stroke patients in stroke care unit. *Erciyes Med J*. 2022; 44(2):138–42. doi: 10.14744/etd.2021.71430
- Widiani GAR, Yasa IMM. Korelasi tingkat pengetahuan terhadap kemampuan deteksi dini gejala stroke dengan sikap keluarga terhadap penanganan pre hospital. *Bina Gener J Kesehat*. 2023; 14(2):25–30. doi: 10.35907/bgjk.v14i2.255
- Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet Neurol*. 2021; 20(10):795–820. doi: 10.1016/S1474-4422(21)00252-0
- Pu L, Wang L, Zhang R, Zhao T, Jiang Y, Han L. Projected global trends in ischemic stroke incidence, deaths and disability-adjusted life years from 2020 to 2030. *Stroke*. 2023; 54(5):1330–9. doi: 10.1161/STROKEAHA.122.040073
- Ojaghihaghghi S, Vahdati SS, Mikaeilpour A, Ramouz A. Comparison of neurological clinical manifestation in patients with hemorrhagic and ischemic stroke. *World J Emerg Med*. 2017; 8(1):34–8. doi:10.5847/wjem.j.1920-8642.2017.01.006
- An SJ, Kim TJ, Yoon B-W. Epidemiology, risk factors, and clinical features of intracerebral hemorrhage: An update. *J Stroke*. 2017; 19(1):3–10. doi: 10.5853/jos.2016.00864
- Chen S, Zeng L, Hu Z. Progressing haemorrhagic stroke: categories, causes, mechanisms and managements. *J Neurol*. 2014; 261(11):2061–78. doi: 10.1007/s00415-014-7291-1
- Patil S, Rossi R, Jabrah D, Doyle K. Detection, diagnosis and treatment of acute ischemic stroke: Current and future perspectives. *Front Med Technol*. 2022; 4. doi: 10.3389/fmedt.2022.748949
- Emberson J, Lees KR, Lyden P, Blackwell L, Albers G, Bluhmki E, et al. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: A meta-analysis of individual patient data from randomised trials. *Lancet*. 2014; 384(9958):1929–35. doi: 10.1016/S0140-6736(14)60584-5
- Herpich F, Rincon F. Management of acute ischemic stroke. *Crit Care Med*. 2020; 48(11):1654–63. doi: 10.1097/CCM.0000000000004597
- Ali RJ, Manorej S, Zafar R. Knowledge of stroke and the window period for thrombolytic therapy in ischemic stroke among South Indians: A hospital-based survey with educational intervention. *J Neurosci Rural Pract*. 2024; 15(1):111–6. doi: 10.25259/JNRP_312_2023
- Yang H, Huang X, Yang C, Zhu S, Chen X, Zhang M, et al. Time window for acute stroke management: A cross-sectional study among community healthcare practitioners in primary care. *Int J Gen Med*. 2022; 15:4483–93. doi: 10.2147/IJGM.S361189
- Rehani B, Ammanuel SG, Zhang Y, Smith W, Cooke DL, Hetts SW, et al. A new era of extended time window acute stroke interventions guided by imaging. *The Neurohospitalist*. 2020; 10(1):29–37. doi: 10.1177/1941874419870701
- Akbarzadeh MA, Sanaie S, Kuchaki Rafsanjani M, Hosseini M-S. Role of imaging in early diagnosis of acute ischemic stroke: A literature review. *Egypt J Neurol Psychiatry Neurosurg*. 2021; 57(1):175. doi: 10.1186/s41983-021-00432-y
- Kikukawa L. Important factors to consider when developing rural healthcare systems: Suggestions from a Moloka'i native. *Hawaii J Med Public Health*. 2017; 76(3 Suppl 1):47–8. [Journal]
- JDIH BPK. PERMENDAGRI Nomor 137 Tahun 2017 tentang Kode dan Data Wilayah Administrasi Pemerintahan. Indonesia; 2017. [Web page]
- Badan Penelitian dan Pengembangan Kesehatan. Laporan Provinsi Maluku Riskesdas 2018. Jakarta; 2019. [Web page]
- Badan Pusat Statistik Provinsi Maluku. Presentase penduduk miskin menurut kabupaten/kota di Provinsi Maluku (persen), 2023-2024. Badan Pusat Statistik. 2024. [Web page]
- Badan Pusat Statistik. Presentase penduduk berumur 15 tahun ke atas yang merokok tembakau selama sebulan terakhir menurut provinsi (persen), 2024. Badan Pusat Statistik(BPS - Statistics Indonesia). 2024. [Web page]
- Effendi DE, Ardani I, Handayani S, Agustiya RI, Nugroho AP, Oktriyanto O, et al. Factors associated with quitting smoking among males: Findings from Indonesian national health survey. *Clin Epidemiol Glob Heal*. 2024; 28:101672. doi: 10.1016/j.cegh.2024.101672
- Badan Penelitian dan Pengembangan Kesehatan. Laporan Riskesdas Nasional 2007. Jakarta; 2007. [Web page]
- Badan Penelitian dan Pengembangan Kesehatan. Laporan Nasional Riskesdas 2018. Jakarta; 2019. [Web page]
- Howard G, Kleindorfer DO, Cushman M, Long DL, Jasne A, Judd SE, et al. Contributors to the excess stroke mortality in rural areas in the United States. *Stroke*. 2017; 48(7):1773–8. doi: 10.1161/STROKEAHA.117.017089
- McMaughan DJ, Oloruntoba O, Smith ML. Socioeconomic status and access to healthcare: Interrelated drivers for healthy aging. *Front Public Heal*. 2020; 8. doi: 10.3389/fpubh.2020.00231
- Istiana M, Yeni Y. The Effect of psychosocial stress on the incidence of hypertension in rural and urban communities. *Media Kesehat Masy Indones*. 2019;15(4):408–17. doi: 10.30597/mkmi.v15i4.7988
- Mukaz DK, Dawson E, Howard VJ, Cushman M, Higginbotham JC, Judd SE, et al. Rural/urban differences in the prevalence of stroke risk factors: A cross-sectional analysis from the REGARDS study. *J Rural Heal*. 2022; 38(3):668–73. doi: 10.1111/jrh.12608
- Talarima B. Faktor risiko kejadian hipertensi pada pasien di ruangan penyakit dalam RSUD Dr. M. Haulussy Ambon. *Glob Heal Sci*. 2016;1(2):66–74. [Journal]
- Suhardi. Preferensi peminum alkohol di Indonesia menurut RISKESDAS 2007. *Bul Penelit Kesehat*. 2011;39(4):154–64. [Journal]
- Adewole S, Mary BF. The phytochemical, proximate and mineral contents of cassava leaves and nutritive values of associated arthropod pests. *J Turkish Chem Soc Sect A Chem*. 2020; 7(3):675–90. doi:10.18596/jotcsa.733516
- Widiarsih A, Susanna D, Eryando T. Consumption of salted fish containing high level of Natrium Chloride (NaCl) with hypertension incidence among people in area of salted fish industry. *Int J Trop Med*. 2017; 12(1):6–14. [Journal]

31. Leksono TP, Hidayat ARP, Silvano F, Lazuardi L. Risk Factors of non-communicable diseases in a frontier, outermost, and least developed (3T) archipelagic region of Indonesia: A community study. Gunadi, Yamada T, Pramana AAC, Ophinni Y, Gusnanto A, Kusuma WA, et al., editors. *BIO Web Conf.* 2021; 41:1–6. doi:10.1051/bioconf/20214103003
32. Pandian JD, Padma Srivastava MV, Aaron S, Ranawaka UK, Venketasubramanian N, Sebastian IA, et al. The burden, risk factors and unique etiologies of stroke in South-East Asia Region (SEAR). *Lancet Reg Heal - Southeast Asia.* 2023; 17:100290. doi:10.1016/j.lansea.2023.100290
33. The GBD 2016 Lifetime Risk of Stroke Collaborators. Global, regional, and country-specific lifetime risks of stroke, 1990 and 2016. *N Engl J Med.* 2018; 379(25):2429–37. doi:10.1056/NEJMoa1804492
34. Rehman S, Sahle BW, Chandra R V., Dwyer M, Thrift AG, Callisaya M, et al. Sex differences in risk factors for aneurysmal subarachnoid haemorrhage: Systematic review and meta-analysis. *J Neurol Sci.* 2019; 406:116446. doi:10.1016/j.jns.2019.116446
35. Vyas M V., Silver FL, Austin PC, Yu AYY, Pequeno P, Fang J, et al. Stroke incidence by sex across the lifespan. *Stroke.* 2021;52(2):447–51. doi:10.1161/STROKEAHA.120.032898
36. Hwong WY, Bots ML, Selvarajah S, Sivasampu S, Reidpath DD, Law WC, et al. Sex differences in stroke metrics among Southeast Asian countries: Results from the Global Burden of Disease Study 2015. *Int J Stroke.* 2019; 14(8):826–34. doi:10.1177/1747493019832995
37. Markidan J, Cole JW, Cronin CA, Merino JG, Phipps MS, Wozniak MA, et al. Smoking and risk of ischemic stroke in young men. *Stroke.* 2018; 49(5):1276–8. doi:10.1161/STROKEAHA.117.018859
38. Boehme AK, Esenwa C, Elkind MSV. Stroke risk factors, genetics, and prevention. *Circ Res.* 2017; 120(3):472–95. doi:10.1161/CIRCRESAHA.116.308398
39. Simmons CA, Poupore N, Nathaniel TI. Age stratification and stroke severity in the telestroke network. *J Clin Med.* 2023;12(4):1519. doi:10.3390/jcm12041519
40. Li A, Ji Y, Zhu S, Hu Z, Xu X, Wang Y, et al. Risk probability and influencing factors of stroke in followed-up hypertension patients. *BMC Cardiovasc Disord.* 2022; 22(1):328. doi:10.1186/s12872-022-02780-w
41. Turana Y, Tengkawan J, Chia YC, Nathaniel M, Wang J, Sukonthasarn A, et al. Hypertension and stroke in Asia: A comprehensive review from HOPE Asia. *J Clin Hypertens.* 2021;23(3):513–21. doi:10.1111/jch.14099
42. Gao J, Dai Y, Xie Y, Zheng J, Wang Y, Guo R, et al. The association of stage 1 hypertension defined by the 2017 ACC/AHA guideline with stroke and its subtypes among elderly chinese. Demarin V, editor. *Biomed Res Int.* 2020; 2020(1). doi:10.1155/2020/4023787
43. Sacco RL, Benjamin EJ, Broderick JP, Dyken M, Easton JD, Feinberg WM, et al. Risk factors. *Stroke.* 1997; 28(7):1507–17. doi:10.1161/01.str.28.7.1507
44. Lau L, Lew J, Borschmann K, Thijs V, Ekinici EI. Prevalence of diabetes and its effects on stroke outcomes: A meta-analysis and literature review. *J Diabetes Investig.* 2019; 10(3):780–92. doi:10.1111/jdi.12932
45. Zhang L, Li X, Wolfe CDA, O'Connell MDL, Wang Y. Diabetes as an independent risk factor for stroke recurrence in ischemic stroke patients: An update meta-analysis. *Neuroepidemiology.* 2021; 55(6):427–35. doi:10.1159/000519327
46. Arboix A. Cardiovascular risk factors for acute stroke: Risk profiles in the different subtypes of ischemic stroke. *World J Clin Cases.* 2015; 3(5):418–29. doi:10.12998/wjcc.v3.i5.418
47. Frerich S, Malik R, Georgakis MK, Sinner MF, Kittner SJ, Mitchell BD, et al. Cardiac risk factors for stroke: A comprehensive mendelian randomization study. *Stroke.* 2022; 53(4). doi:10.1161/STROKEAHA.121.036306