RELATIONSHIP OF DIABETES MELLITUS AND HYPERTENSION TO THE INCIDENCE OF STROKE IN MALE

[1]Rizki Nugraha Agung, [2]Sinta Wijayanti, [3]Diany Fauziyah
[1,3]Faculty of Nursing, University of Muhammadiyah Jakarta
[2]Faculty of Nursing, University of Jember

Corresponding Author; University of Jember; sintawijayanti@unej.ac.id;

ABSTRACT

Introduction: Stroke is the second leading cause of death worldwide. In 2024, the World Health Organization reported that there are 15 million stroke cases year worldwide, of which 5 million resulted in death, 5 million in disability, and the remaining number placed a strain on the family. Stroke is Indonesia's leading cause of death and disability, accounting for 18.5% of all fatalities and 11.2% of all disabilities. The prevalence of stroke was 8.3 per 1,000 people. Stroke risk factors include age, gender, diet, smoking, inactivity, diabetes, and high blood pressure. Diabetes and hypertension are two of these risk factors that can significantly enhance the risk of stroke and have a fast-growing epidemic. The aim of this paper is to determine the relationship of diabetes mellitus and hypertension to the incidence of stroke in male. **Methods:** This study used cross-sectional descriptive analysis as its research method, and it included 90 respondents in total. **Results:** Data analysis used in this study was the Chi square test which showed there was a relationship between diabetes (p-value:0.009) and hypertension (p-value:0.026) with stroke incidence. **Discussion:** The results of the study showed that there is an association between diabetes and hypertension with the incidence of stroke.

Keywords: Diabetes Mellitus, Hypertension, Incidence of Stroke

Introduction

Stroke is a disorder that occurs in the neuro system, often accompanied by attacks that result in death or disability occurring briefly (Lionel Ginsberg, 2019). Stroke causes damage to brain tissue and disrupts brain function due to reduced blood flow and oxygen to the brain. The reduction in blood flow to the brain is caused by either the brain's blood vessel arteries narrowing or blood vessel rupture, which results in obstruction and hemorrhage. Accordingly, it may lessen and prevent the flow of oxygen to brain cells, resulting in a deterioration and disturbance of nerve activity (Aulyra Familah et al., 2024).

Based on its pathological abnormalities, stroke is divided into two types: hemorrhagic stroke and ischemic stroke (Selvirawati et al., 2021). A neurological condition known as hemorrhagic stroke is brought on by blood vessel rupture. A neurological condition known as an ischemic stroke is brought on by blockages in the brain's arterial blood vessels, which

results in a diminished or even nonexistent blood flow to specific brain regions (Mutiarasari, 2019).

Stroke is a disease that has a high risk of mortality, being the second leading cause of death in the world. According to WHO in 2024, the prevalence of stroke cases is known to be 15 million people each year worldwide. From this number of stroke patients, it is known that 5 million people die, 5 million people become disabled, and the rest become a burden on their families (World Health Organization, 2025). The incidence of stroke in Indonesia is the highest cause of death and disability in the country, accounting for 18.5% of deaths and 11.2% of disabilities. The prevalence of stroke in Indonesia reaches 8.3 per 1,000 population, with the third highest disease expenditure after heart disease and cancer, amounting to 5.2 trillion rupiah in 2023 (Kemenkes, 2024).

In the DKI Jakarta region, the prevalence of stroke is 12.2%, affecting 28,985 people. Based on this, DKI Jakarta is one of the 10 provinces with the highest incidence of stroke in Indonesia (Riset Kesehatan Dasar (Riskesdas), 2018).

Furthermore, based on the research conducted by Nugraha Agung et al., (2024) at one of the state hospitals in the North Jakarta area, it was stated that out of 102 respondents, the majority of stroke patients were male, with 62 respondents (60.8%), and female stroke patients numbered 40 respondents (39.2%). Therefore, in the DKI Jakarta area, stroke cases are more prevalent among men compared to women.

Stroke reduces blood flow and oxygen to the brain, it damages brain tissue and impairs brain function. The reduction in blood flow to the brain is caused by either the brain's blood vessel arteries narrowing or blood vessel rupture, which results in obstruction and hemorrhage. Accordingly, it may lessen and prevent the flow of oxygen to brain cells, resulting in a deterioration and disturbance of nerve activity (Mutiarasari, 2019). Some non-modifiable risk factors include age, gender, and family history. Furthermore, modifiable risk factors include hypertension, smoking, diabetes mellitus, obesity, alcohol, and cholesterol. Among these risk factors, diabetes and hypertension are diseases with very rapid epidemiological development, which can lead to a substantial increase in stroke incidence (Utama & Nainggolan, 2022).

According to Amalia et al. (2024), 87% of stroke risk factors are hypertension. In the study, it was found that there is a relationship between hypertension and the occurrence of stroke. In hypertensive patients, there is a narrowing of blood vessels in the brain, leading to a stroke. In stroke patients with hypertension, there is a risk of hemorrhagic stroke and a risk of recurrent stroke (Muthmainnah et al., 2022).

Another stroke risk factor with a high percentage is diabetes mellitus (35%) (Rahayu, 2023). According to the research,

it is known that there is a relationship between diabetes and the occurrence of stroke. In patients with diabetes mellitus, there is vascular stiffness that increases the risk of stroke. In diabetes mellitus, elevated hyperglycemia increases the risk of worse outcomes in stroke patients compared to those with normal glycemia. Furthermore, stroke patients with diabetes mellitus risk factors experience worse post-stroke outcomes and have a high risk of disease recurrence (Mosenzon et al., 2023).

Based on the above description, diabetes and hypertension are important risk factors for stroke occurrence and can worsen and cause recurrent episodes in stroke patients. Therefore, the researchers are interested in conducting a study on the "Relationship Between Diabetes and Hypertension to The Incidence of Stroke Incidence in Men" at the Islamic Hospital Jakarta Cempaka Putih. The purpose of this research is to determine the relationship between diabetes and hypertension to the incidence of stroke in Men.

Methods

The research method used in this study is descriptive analytic with a cross-sectional study. The research sample was taken using a non-probability sampling technique with a purposive sampling method.

The total sample in this study amounted to 90 patients at Rumah Sakit Islam Jakarta Cempaka Putih. The inclusion criteria for the study are: 1) Male patients diagnosed with stroke in the neurology outpatient and inpatient departments of RS. Islam Jakarta Cempaka Putih, 2) Stroke patients with a history of previous strokes or newly diagnosed with stroke, 3) Patients or their guardians willing to participate as respondents by signing the informed consent. The exclusion criteria for the study are: 1) Patients who have signs and symptoms of stroke but have not been diagnosed or confirmed by medical examination.

The measurement tool used in this study is a questionnaire that contains a format for collecting basic respondent data. The data includes the name (initials) of the patient, the age of the patient, and the previous medical history, namely diabetes mellitus and hypertension.

Research ethics are considered by researchers when conducting their studies. The ethics used in the research refer to the ethical principles of respect for human dignity, beneficence and non-maleficence, and justice (Kemenkes, 2021).

Data analysis was conducted using the SPSS program. Data analysis was performed univariately and bivariately using the non-parametric chi-square test.

Results

Univariate Analysis

Table 1. Frequency Distribution of Respondents Based on Respondent Characteristics (n=90)

Variable	Frequency	Percentage
Age		
Early Age	17	18,89%
Middle Age	34	37,78%
Elderly	39	43,33%
Education		
Not School	3	3,33%
Elementary	14	15,55%
School Junior	23	25,56%
High School High	45	50%
School College	5	5,56%
Work		
Not Working	26	28,89%
Working	64	71,11%

Based on Table 1, it is known that the age proportion of respondents is mostly elderly (≥60 years) with 39 people (43.33%), the rest being 34 people (37.78%) in middle age (45-59 years), and 17 people (18.89%) in early age (17-44 years). The proportion based on the respondents' education shows that the majority have a high school education, with 45 people (50%), followed by 23 people (25.56%) with a junior high school education, 14 people (15.55%) with an elementary school education, 5 people (5.56%) with higher education, and 3 people (3.33%). Furthermore, the proportion based on the respondents' employment status indicates that the majority are employed, with 64 people (71.11%) compared to 26 people (28.89%) who are not employed.

Table 2. Frequency Distribution of Respondents Based on Research Variables (n=90)

Variable	Frequency	Percentage
Diabetes Mellitus		
Yes	44	48,89%
No	46	51,11%
Hypertension		
Yes	53	58,90%
No	37	41,10%

Based on Table 2, it is known that the proportion of respondents with a history of diabetes is 44 people (48.89%), while the remaining 46 people (51.11%) do not have a history of diabetes. Furthermore, the proportion of respondents with a history of hypertension is 53 people (58.90%), while the remaining 37 people (41.10%) do not have a history of hypertension.

Bivariate Analysis

Table 3. The Relationship between Diabetes Mellitus and Hypertension with the Incidence of Stroke in Men (n=90)

Variable	OR	*P-Value*
Diabetes Mellitus and the Incidence of Stroke	6,6	0,009
Hypertension and the Incidence of Stroke	3,9	0,026

Based on Table 3, it is known that there is a relationship between diabetes mellitus and the incidence of stroke in men with a p-value of 0.009. Furthermore, the relationship between hypertension and the incidence of stroke in men has a p-value of

0.026. Based on Table 3, an OR of 6.6 was found in diabetes mellitus patients, meaning that respondents with a history of diabetes mellitus are 6.6 times more likely to have a stroke, and an OR of 3.9 in hypertension patients, meaning that respondents with a history of hypertension are 3.9 times more likely to have a stroke.

Discussion

Respondent Characteristics

Based on the research results regarding the age proportion of respondents, the elderly group (≥60 years) is the largest, followed by the middle-aged and young age groups. These findings indicate that as a person's age increases, the percentage of respondents who experience a stroke tends to rise. This is in line with the research conducted by Widyasari et al., (2022), which indicates that age is a significant risk factor for stroke occurrence, with the risk doubling every five years after the age of 65.

In men, the risk of stroke increases with age. Several studies show that men have a higher tendency to experience strokes compared to women, especially after the age of 60. Risk factors such as hypertension, diabetes, and smoking habits, which are more common in men, also contribute to the increased incidence of strokes in this age group (Utama & Nainggolan, 2022 ; Ji et al., 2023).

Furthermore, social and economic factors also influence the incidence of stroke among elderly men. Men from lower socioeconomic backgrounds may have more limited access to healthcare, leading to suboptimal detection and management of stroke risks. Therefore, health education and interventions targeting elderly men are essential, given the high prevalence of stroke in this group, to raise awareness about risk factors and the importance of good health management (Edzie et al., 2021).

The proportion of respondents based on education is highest among those with high school education, followed by those with junior high school, elementary school, higher education, and those who have never attended school, who have the lowest proportion. Based on the data, it shows that the higher the level of education a person has, the percentage of respondents who experience a stroke tends to increase. Furthermore, in this study's results, the percentage of stroke cases among respondents with elementary, middle, and high school education appears to increase sequentially. Conversely, among respondents with higher education, the percentage is recorded at 5%. Although this figure is higher compared to respondents who have never attended school, who show the lowest percentage of strokes.

Based on this, it shows that although education is often associated with increased health awareness, access to health information and services, and better health risk management, there is also the possibility that individuals with higher education may be exposed to certain risk factors that contribute to the occurrence of strokes (Yu et al., 2021). Some studies

suggest that higher levels of education may be associated with a less healthy lifestyle, such as sedentariness and high mental stress, which could contribute to an increased risk of stroke among educated individuals. Individuals with higher education may face greater job demands and increased stress, which in turn can lead to cardiovascular risk factors (Xiuyun et al., 2020).

Furthermore, in the study by Akyea et al., (2021) it was observed that men with secondary education tend to be exposed to higher health risk factors, which could explain the higher prevalence of stroke in this group. Conversely, women show a different pattern, where psychosocial factors and stress also affect their health risks, although the data does not directly address education.

In men with higher education, they may be more aware of stroke risk factors, making them more proactive in taking preventive measures and health control (Kholifah et al., 2020). However, even though men with higher education have a better understanding of health, they also face different challenges. Research conducted by Kartini & Mukaddas, (2022) shows that highly educated men tend to be exposed to higher work-related stress, which may contribute to an increase in stroke incidence among them.

The proportion of respondents based on their occupation shows that the percentage of respondents who are employed is higher compared to those who are unemployed, which is (71.11%). This provides an important insight into how employment status can affect health, particularly the risk of stroke in men.

Men, as a group often involved in more risky jobs, may be more exposed to stress factors due to job demands as well as unhealthy lifestyle habits, such as poor diet and lack of physical activity (Bertoni et al., 2024).
Additionally, men tend to be involved in types of work that are more risky, both physically and mentally (Wolf et al., 2022).

Research also shows that socio economic status can affect the likelihood of stroke occurrence. Men from low socio economic status backgrounds often do not have adequate access to healthcare and rehabilitation services, which can worsen their stroke outcomes (Buus et al., 2022). Therefore, the working population, especially men, need special attention in stroke prevention efforts, including through workplace education programs, better health promotion, and interventions related to a healthy lifestyle (Backhouse et al., 2021).

The Relationship Between Diabetes Mellitus and the Incidence of Stroke in Men

Based on the research results, it is known that there is a relationship between diabetes mellitus and the incidence of

stroke in men with a p-value of 0.009. These research findings are in line with the study by Sari & Fatmawati, (2023) that among patients who experienced a stroke, those with a history of diabetes mellitus had a higher incidence of stroke with a p-value of 0.009.

Diabetes mellitus, characterized by high blood glucose levels, causes various health complications that can affect the cardiovascular system, including an increased risk of stroke (Yuda et al., 2021). This is in line with the results of this study, which indicate that diabetes mellitus is 6.6 times more likely to result in a stroke, with an OR value of 6.6. According to Amalia et al., (2024) patients with diabetes mellitus are 2.7 times more likely to experience a stroke compared to those without a history of DM. This study explains that complications from diabetes can worsen existing health conditions, such as hypertension, which is also a risk factor for stroke (Hidayati et al., 2021).

Especially in men with a history of diabetes mellitus, there is an increased risk of recurrent stroke and neurological complications (Tawhid & Habib, 2023). Furthermore, in the study conducted by Indriasari et al., (2023) it was found that diabetes mellitus shows a strong association with the incidence of stroke, with a significant proportion among patients experiencing ischemic stroke, where 45 out of 60 ischemic stroke patients had type 2 diabetes mellitus.

Furthermore, this study shows that the proportion of stroke patients, which is 44 people (48.89%), with a history of diabetes mellitus is slightly lower compared to those without a history of diabetes. However, there remains a significant relationship between diabetes mellitus (DM) and the occurrence of stroke. Overall, although the proportion of stroke patients with a history of diabetes may vary, it is very clear that diabetes acts as a significant risk factor for the occurrence and poor outcomes after a stroke. Diabetes is known as a risk factor that contributes to the increased incidence of ischemic stroke, with the prevalence of diabetes among stroke patients recorded to range from 5.1% to 69.4% depending on the population studied (Alhazzani et al., 2021).

The study conducted by Zhang et al., (2021) revealed that diabetes is not only a risk factor for stroke occurrence but also acts as an independent factor for stroke recurrence in patients who have experienced ischemic stroke. The study reported that diabetes can worsen clinical outcomes after a stroke, although these outcomes varied among the studied populations and over different follow-up periods. This indicates that although there is variation in the proportion of stroke patients with diabetes, the impact of diabetes on stroke incidence remains crucial (Gustian et al., 2023).

Another factor to consider is the comorbid conditions where diabetic patients often experience other health issues such as

hypertension, dyslipidemia, and obesity, all of which are associated with an increased risk (Flach et al., 2020). Research by Alhazzani et al., (2021) indicates that the vascular conditions frequently occurring in diabetic patients can increase the risk of stroke, highlighting the complex relationship between diabetes and cardiovascular diseases, including stroke.

Physiologically, diabetes mellitus plays an important role in increasing the risk of stroke through several complex biological mechanisms. One of the main mechanisms is through endothelial dysfunction and atherosclerosis. Diabetes causes endothelial dysfunction, which reduces the ability of blood vessels to respond to changes in blood flow and increases systemic inflammation, which in turn accelerates the process of atherosclerosis (Utami et al., 2024).

Atherosclerosis will cause the accumulation of fatty plaques in the arterial walls, contributing to the occurrence of ischemic stroke. Research by Amalia et al. shows that individuals with diabetes have a 2.7 times higher risk of stroke compared to those without diabetes (Amalia et al., 2024). Furthermore, the mechanisms involving changes in lipid and glucose metabolism due to DM further affect blood coagulation by increasing platelet aggregation and blood viscosity, thereby triggering the formation of clots that can block brain arteries (Yuda et al., 2021).

Furthermore, the stress response also has physiological effects, where stress will cause hyperglycemia. The increase in blood glucose levels exacerbated by stress, which is often experienced by stroke patients, can disrupt energy metabolism and cause further damage to nerve tissue (Yuda et al., 2021). According to Zhang et al., (2021) hyperglycemia can contribute to recurrent strokes by destroying nerve cells and increasing cell death, potentially adding challenges to post-stroke rehabilitation.

Diabetes is also associated with other comorbidities, such as hypertension and dyslipidemia, which are very important to consider. High blood pressure and LDL cholesterol levels, when combined with diabetes, worsen the risk of stroke. Research shows that dyslipidemia is very common among diabetes patients, highlighting the importance of cholesterol management to reduce vulnerability to stroke (Yuda et al., 2021).
Based on this, good diabetes management and control of vascular risk factors are important steps to reduce the likelihood of stroke occurrence. Public health interventions focused on the prevention and management of diabetes, as well as the control of hypertension and cholesterol levels, can help reduce the incidence of stroke in a broader population (Sumiyati et al., 2021).

The Relationship Between Hypertension and Stroke Incidence in Men

Berdasarkan hasil penelitian diketahui Based on the research results, it was found that the proportion of stroke patients was 53 people (58.90%) with a history of hypertension compared to those without a history of hypertension, and there is a significant relationship between stroke incidence in men with a p-value of 0.026. This study also obtained an OR value of 3.9, which means that hypertension is at risk of 3.9 times experiencing a stroke in men. This study is in line with the research by Mandagi et al., (2022) which confirmed that hypertension has a significant relationship in increasing the risk of stroke. Hypertension is one of the main risk factors for stroke occurrence, and its impact can be greater in men compared to women.

Physiologically, hypertension causes changes in the vascular and heart systems, which can lead to serious complications such as stroke. In hypertensive conditions, the arterial walls experience increased stress due to higher pressure from blood flow, which can cause damage to the endothelium, a thin layer of cells lining the blood vessels, and increase the risk of atherosclerosis, which is the buildup of fat, cholesterol, and other substances in the arteries (Puspitasari, 2020). This causes damage to blood vessels and the formation of blood clots. In the long term, increased blood pressure can lead to cardiomegaly and increased cardiac preload, which ultimately contributes to heart dysfunction. If the heart is unable to pump blood effectively, this can lead to brain ischemia due to inadequate blood flow (Hidayati et al., 2021).

Moreover, hypertension also affects the increase in vascular resistance, which can worsen other conditions, such as diabetes and dyslipidemia, thereby contributing to the increased risk of stroke. In other words, individuals with hypertension not only experience elevated blood pressure but are also simultaneously exposed to other cardiovascular risk factors (Puspitasari, 2020).

Furthermore, in the study by Shakila & Wahyuliati, tahun (2023) it was found that based on gender, men with hypertension have a higher risk of stroke compared to women. This may be caused by various factors, including lifestyle and dietary patterns that generally differ between men and women, as well as risk factors such as higher smoking and alcohol consumption among men (Napitupulu & Ahmad, 2021).

As a preventive measure, managing hypertension should be a priority in clinical practice. Education about a healthy lifestyle, such as dietary management, physical activity, and avoiding smoking can help lower blood pressure and consequently reduce the risk of stroke (Marlina et al., 2021). A healthy lifestyle, including a low-salt diet and regular physical activity, has been proven effective in lowering blood pressure and reducing the risk of stroke. Proper interventions can improve patients' quality of life and reduce the potential occurrence of life-threatening strokes.

(Khotimah et al., 2021).

Conclusion

The conclusion of this study is that there is a significant relationship between diabetes mellitus and hypertension with the incidence of stroke in men at Rumah Sakit Islam Jakarta Cempaka Putih. Based on this, the provision of health promotion for the prevention and management of diabetes and the control of hypertension is recommended to reduce the incidence of stroke. Health promotion related to the management of diabetes and hypertension, as well as the control of risk factors such as lifestyle, can be provided to reduce the likelihood of stroke occurrence in men.

References

Akyea, R. K., Vinogradova, Y., Qureshi, N., Patel, R., Kontopantelis, E., Ntaios, G., Asselbergs, F. W., Kai, J., & Weng, S. (2021). Sex, Age, and Socioeconomic Differences in Nonfatal Stroke Incidence and Subsequent Major Adverse Outcomes. *Stroke*, *52*(2), 396–405. https://doi.org/10.1161/strokeaha.120.031659

Alhazzani, A., Mahfouz, A. A., Abolyazid, A. Y., & Awadalla, N. J. (2021). Risk Factors of the First-Time Stroke in the Southwest of Saudi Arabia: A Case-Control Study. *Brain Sciences*, *11*(2), 222. https://doi.org/10.3390/brainsci11020222

Amalia, N., Widyaningsih, V., & Ichsan, B. (2024). Meta-Analysis the Effects of Hypertension, High Density Lipoprotein, and Diabetes Mellitus on the Risk of Stroke. *Indonesian Journal of Medicine*, *8*(4), 435–451. https://doi.org/10.26911/theijmed.2023.08.04.10

Aulyra Familah, Arina Fathiyyah Arifin, Achmad Harun Muchsin, Mochammad Erwin Rachman, & Dahliah. (2024). Karakteristik Penderita Stroke Iskemik dan Stroke Hemoragik. *Fakumi Medical Journal: Jurnal Mahasiswa Kedokteran*, *4*(6), 456–463. https://doi.org/10.33096/fmj.v4i6.468

Backhouse, E. V, Shenkin, S. D., McIntosh, A. M., Bastin, M. E., Whalley, H. C., Hernandez, M. V., Maniega, S. M., Harris, M. A., Stolicyn, A., Campbell, A., Steele, J. D., Waiter, G. D., Sandu, A., Waymont, J. M. J., Murray, A. D., Cox, S. R., Rooij, S. R. de, Roseboom, T. J., & Wardlaw, J. M. (2021). Early Life Predictors of Late Life Cerebral Small Vessel Disease in Four Prospective Cohort Studies. *Brain*, *144*(12), 3769–3778. https://doi.org/10.1093/brain/awab331

Bertoni, D., Bruni, S., Saviola, D., Tanti, A. De, & Costantino, C. (2024). The Role of Cognitive Reserve in Post-Stroke Rehabilitation Outcomes: A Systematic Review. *Brain Sciences*, *14*(11), 1144. https://doi.org/10.3390/brainsci14111144

Buus, S. M. Ø., Schmitz, M. L., Cordsen, P., Johnsen, S. P., Andersen, G., & Simonsen, C. Z. (2022). Socioeconomic Inequalities in Reperfusion Therapy for Acute Ischemic Stroke. *Stroke*, *53*(7), 2307–2316. https://doi.org/10.1161/strokeaha.121.037687

Edzie, E. K. M., Gorleku, P. N., Dzefi‐Tettey, K., Idun, E. A., Amankwa, A. T., Aidoo, E., Asemah,

A. R., & Kusodzi, H. (2021). Incidence Rate and Age of Onset of First Stroke From CT Scan Examinations in Cape Coast Metropolis. *Heliyon*, *7*(2), e06214. https://doi.org/10.1016/j.heliyon.2021.e06214

Flach, C., Muruet, W., Wolfe, C., Bhalla, A., & Douiri, A. (2020). Risk and Secondary Prevention of Stroke Recurrence. *Stroke*, *51*(8), 2435–2444. https://doi.org/10.1161/strokeaha.120.028992

Gustian, A. U., Safirza, S., & Mursyida, M. (2023). Hubungan Kadar Gula Darah Sewaktu Dengan Kejadian Stroke Di Rumah Sakit Meuraxa Banda Aceh Tahun 2023. *Media Kesehatan Masyarakat Indonesia*, *22*(4), 266–270. https://doi.org/10.14710/mkmi.22.4.266-270

Hidayati, A., Martini, S., & Hendrati, L. Y. (2021). Determinan Kejadian Stroke Pada Pasien Hipertensi (Analisis Data Sekunder IFLS 5). *Jurnal Kesehatan Global*, *4*(2), 54–65. https://doi.org/10.33085/jkg.v4i2.4794

Indriasari, I., Sahreni, S., & Pratama, A. (2023). Hubungan Diabetes Melitus Tipe 2 Dengan Stroke Iskemik Pada Pasien Poliklinik Saraf Di Rumah Sakit Budi Kemuliaan Kota Batam Tahun 2021. *Zona Kedokteran Program Studi Pendidikan Dokter Universitas Batam*, *13*(1), 342–350. https://doi.org/10.37776/zked.v13i1.1153

Ji, X., Tao, M., Guo, H., Wang, W., Wang, P., Jin, L., Yuan, H., Peng, H., & Ye, M. (2023). *Age-Period-Cohort Analysis of Stroke Incidence in China and India From 1990 to 2019 and Predictions Up to 2042*. https://doi.org/10.21203/rs.3.rs-2648089/v1

Kartini, K., & Mukaddas, H. (2022). Hubungan Pendidikan Ibu Dengan Kejadian Kekurangan Energi Kronik Pada Ibu Hamil Pada Masa Pandemik COVID-19 Di Wilayah Kerja Puskesmas Kabupaten Konawe. *Jurnal Stunting Pesisir Dan Aplikasinya*, *1*(1). https://doi.org/10.36990/jspa.v1i1.455

Kemenkes. (2021). Pedoman dan Standar Penelitian dan Pengembangan Kesehatan Nasional. In *Komisi Etik Penelitian dan Pengembangan Keseheatan Nasional*.

Kemenkes. (2024). *Cegah Stroke dengan Aktivitas Fisik*. https://kemkes.go.id/id/rilis-kesehatan/cegah-stroke-dengan-aktivitas-fisik

Kholifah, S. H., Budiwanto, S., & Katmawanti, S. (2020). Sosioekonomi, Obesitas, Dan Riwayat Diabetes Melitus (DM) Dengan Kejadian Hipertensi. *Jurnal Penelitian Dan Pengembangan Kesehatan Masyarakat Indonesia*, *1*(2), 157–165. https://doi.org/10.15294/jppkmi.v1i2.40323

Khotimah, A., Purnomo, P. S., & Amry, R. Y. (2021). Pengaruh Keturunan, Obesitas Dan Gaya Hidup Yang Mempengaruhi Risiko Hipertensi Pada Lansia Di Wilayah Kerja Puskesmas Pandak II Bantul DIY Tahun 2019. *Jurnal Ilmiah Kesehatan Masyarakat Media Komunikasi Komunitas Kesehatan Masyarakat*, *13*(1), 34–40. https://doi.org/10.52022/jikm.v13i1.106

Lionel Ginsberg. (2019). *Lecture Notes: Neurologi*. Erlangga. https://www.google.co.id/books/editio

n/Panduan_Lengkap_Stroke/UmVcEAAAQBAJ?hl=id&gbpv=1&dq=stroke+adalah&pg=PA538&printsec=frontcover

Mandagi, A. M., Ulfa, I. F., Prayogi, A. R. Y., Pratama, R. A., Adnin, A. B. A., Aisyiyah, F. A. N., & Katmawanti, S. (2022). Analisis Status Depresi Sebagai Faktor Penyebab Hipertensi Berbasis Gender Di Indonesia (Studi Indonesian Family Life Survey 5). *Preventia the Indonesian Journal of Public Health*, *7*(1), 14. https://doi.org/10.17977/um044v7i12022p14-19

Marlina, Nurhidayah, I., Ibrahim, & Fitria, N. (2021). Pengelolaan Hipertensi dan Diabetes Mellitus dalam Mencegah Stroke di Banda Aceh: Indonesia. *Tropical Public Health Journal*, *1*, 31–36. https://doi.org/10.32734/trophico.v1i1.6044

Mosenzon, O., Cheng, A. Y. Y., Rabinstein, A. A., & Sacco, S. (2023). Diabetes and Stroke: What Are the Connections? *J Stroke*, *25*(1), 26–38. https://doi.org/10.5853/jos.2022.02306

Muthmainnah, P. R., Syahril, K., Rahmawati, Nulanda, M., & Dewi, A. S. (2022). Fakumi medical journal. *Jurnal Mahasiswa Kedokteran*, *2*(5), 359–367.

Mutiarasari, D. (2019). MEDIKA TADULAKO , Jurnal Ilmiah Kedokteran, Vol. 6 No. 1 Januari 2019. *Jurnal Ilmiah Kedokteran*, *6*(1), 45–54.

Napitupulu, M., & Ahmad, H. (2021). Hubungan Pengetahuan Lansia Tentang Stroke Dengan Tindakan Pencegahan Stroke Tahun 2021. *Jurnal Kesehatan Ilmiah Indonesia (Indonesian Health Scientific Journal)*, *6*(2), 29. https://doi.org/10.51933/health.v6i2.496

Nugraha Agung, R., Jumaiyah, W., Siswandi, I., Rinawati, & Jum'atina. (2024). Gejala primer serangan stroke pada pasien dengan serang pertama. *Journal of Telenursing (JOTING)*, *6*(01), 147–155. https://doi.org/10.31539/joting.v6i1.8378

Puspitasari, P. N. (2020). Hubungan Hipertensi Terhadap Kejadian Stroke. *Jurnal Ilmiah Kesehatan Sandi Husada*, *12*(2), 922–926. https://doi.org/10.35816/jiskh.v12i2.435

Rahayu, T. G. (2023). Analisis Faktor Risiko Terjadinya Stroke Serta Tipe Stroke. *Faletehan Health Journal*, *10*(01), 48–53. https://doi.org/10.33746/fhj.v10i01.410

Riset Kesehatan Dasar (Riskesdas). (2018). Laporan Riskesdas 2018 Nasional.pdf. In *Lembaga Penerbit Balitbangkes* (p. hal 156). https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan Riskesdas 2018 Nasional.pdf

Sari, M., & Fatmawati, F. (2023). Hubungan Diabetes Melitus Dengan Kejadian Stroke Berulang Pada Pasien Post Stroke Di Rumah Sakit Umum Daerah Aceh Utara. *Jurnal Kesehatan Akimal*, *2*(1), 31–36. https://doi.org/10.58435/jka.v2i1.63

Selvirawati, S., Wahab, A., & Rizarullah, R. (2021). Perbedaan Profil Lipid Pasien Stroke Iskemik Dan Stroke Hemoragik Di Rsud Meuraxa Kota Banda Aceh. *Jurnal Medika Malahayati*, *4*(3), 236–243. https://doi.org/10.33024/jmm.v4i3.3149

Shakila, S. D., & Wahyuliati, T. (2023).

Hubungan Kardiomegali Dengan Hipertensi Pada Pasien Stroke. *Jurnal Kesehatan Tambusai*, *4*(4), 5812–5818. https://doi.org/10.31004/jkt.v4i4.20645

Sumiyati, S., Umami, N. Z., & Simarmata, M. M. (2021). Pengaruh Diabetes Melitus Terhadap Mata. *Jurnal Mata Optik*, *2*(2), 1–9. https://doi.org/10.54363/jmo.v2i2.36

Tawhid, M. H., & Habib, K. (2023). Association Between Hemorrhagic Stroke and Diabetes Mellitus; A Hospital-Based Case-Control Study. *Journal for Research in Applied Sciences and Biotechnology*, *2*(6), 37–42. https://doi.org/10.55544/jrasb.2.6.7

Utama, Y. A., & Nainggolan, S. S. (2022). Faktor Resiko yang Mempengaruhi Kejadian Stroke: Sebuah Tinjauan Sistematis. *Jurnal Ilmiah Universitas Batanghari Jambi*, *22*(1), 549. https://doi.org/10.33087/jiubj.v22i1.1950

Utami, S., Wicaksono, E. N., Choirunnisa, A., Veibiani, N. A., & Murti, B. (2024). Effects of Hypertension, Diabetes Mellitus, and Gender on Post Stroke Cognitive Impairment: Meta-Analysis. *Journal of Epidemiology and Public Health*, *9*(1), 68–82. https://doi.org/10.26911/jepublichealth.2024.09.01.07

Widyasari, V., Rahman, F. F., & Ningrum, V. (2022). *The Incidence and Prevalence of Stroke by Cause in Indonesia Based on Global Burden of Disease Study 2019*. 435–446. https://doi.org/10.2991/978-94-6463-048-0_50

Wolf, S., Holm, S. E., Ingwersen, T., Bartling, C., Bender, G., Birke, G., Meyer, A., Nolte, A., Ottes, K., Pade, O., Peller, M., Steinmetz, J., Gerloff, C., & Thomalla, G. (2022). Pre-Stroke Socioeconomic Status Predicts Upper Limb Motor Recovery After Inpatient Neurorehabilitation. *Annals of Medicine*, *54*(1), 1265–1276. https://doi.org/10.1080/07853890.2022.2059557

World Health Organization. (2025). *Stroke, Cerebrovascular Accident*. https://www.emro.who.int/health-topics/stroke-cerebrovascular-accident/index.html

Xiuyun, W., Wu, Q., Minjun, X., Wei-dong, L. I., & Lizhen, L. (2020). Education and Stroke: Evidence From Epidemiology and Mendelian Randomization Study. *Scientific Reports*, *10*(1). https://doi.org/10.1038/s41598-020-78248-8

Yu, Y., Lei, D., He, Q., & Chen, W. (2021). A Cohort Study on the Relationship Between Education Level and High‐risk Population of Stroke. *Ibrain*, *7*(3), 181–191. https://doi.org/10.1002/j.2769-2795.2021.tb00082.x

Yuda, H. T., Munajah, A., & Yuwono, P. (2021). *The Relationship of Smoking Habits, Cholesterol Level and Diabetes Mellitus (DM) History With Stroke Incidence in Patients at PKU Muhammadiyah Hospital Sruweng*. https://doi.org/10.2991/ahsr.k.210115.082

Zhang, L., Li, X., Wolfe, C., O'Connell, M., & Wang, Y. (2021). Diabetes as an Independent Risk Factor for Stroke Recurrence in Ischemic Stroke Patients: An Updated Meta-Analysis. *Neuroepidemiology*, *55*(6), 427–435. https://doi.org/10.1159/000519327