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THE PROPORTION OF LEUKOCYTE, HEMATOCRIT, NUTRITIONAL STATUS, HEART DISEASE, AND DIABETES: HYPERTENSION AS THE DOMINANT FACTOR OF NON-HEMORRHAGIC STROKE

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Abstrak

Latar Belakang: Stroke menjadi penyebab kematian kedua di dunia dan penyebab kecacatan jangka panjang nomor satu, Prevalensi stroke non hemoragik cukup banyak antara 70% - 85% dan beberapa faktor risiko antara lain hipertensi dan diabetes mellitus. Tujuan penelitian mengetahui perbedaan proporsi kadar leukosit, kadar hematokrit, status gizi, riwayat jantung, riwayat diabetes melitus, riwayat hipertensi, dengan kejadian stroke non hemoragik.

Metode: Desain penelitian menggunakan cross-sectional studi. Populasi penelitian pasien dengan penyakit syaraf yang ada di RSUD. Prof. Dr. Margono Soekarjo Purwokerto. Instrumen penelitian menggunakan lembar ceklist berdasarkan data rekam medis pasien mulai Januari sampai Desember 2023 yang dirawat di Ruang Anyelir RSUD. Margono. Teknik Pengambilan sampel menggunakan teknik purpose sampling berdasarkan kriteria inklusi dan eksklusi didapatkan sampel sebanyak 102 responden. Analisis dengan regresi logistik binomial untuk mengidentifikasi faktor yang paling dominan terjadinya stroke non hemoragik.

Hasil: Penelitian menunjukkan pada kejadian yang terkena stroke non hemoragik didapatkan data dengan riwayat diabetes mellitus 15,3 %, riwayat penyakit jantung 21,3 %, riwayat hipertensi 46,7 %, kadar lipid tidak normal 8,7 %, kadar hematokrit tidak normal 9,3 %, kadar leukosit tidak normal 24 %, dan status gizi obesitas 15,3 %. Ada hubungan antara riwayat Hipertensi (p=0,0001), riwayat DM (p=0,001), riwayat penyakit jantung (p=0,001).

Kesimpulan: Hipertensi merupakan faktor dominan terjadinya stroke non haemorhagic, Masyarakat diharapkan lebih waspada dengan berbagai penyakit yang berhubungan dengan terjadinya stroke non haemoragic.

Abstract

Background: Stroke is the second leading cause of death in the world and the number one cause of long-term disability, The prevalence of non-hemorrhagic stroke is quite high between 70% - 85%, and several risk factors include hypertension and diabetes mellitus. The purpose of the study was to determine the differences in the proportion of leukocyte levels, hematocrit levels, nutritional status, heart history, history of diabetes mellitus, and history of hypertension, with the incidence of non-hemorrhagic stroke.

Method: The research design used a cross-sectional study. The study population was patients with neurological diseases treated at Prof. Dr. Margono Soekarjo Purwokerto Regional Hospital. The research instrument used a checklist sheet based on patient medical record data from January to December 2023 who were treated in the carnation room of Margono Hospital. The sampling technique used a purpose sampling technique based on inclusion and exclusion criteria, a sample of 102 respondents was obtained. Analysis with binomial logistic regression to identify the most dominant factors in the occurrence of non-hemorrhagic stroke.

Results: The study showed that in the incidence of positive non-hemorrhagic stroke, data was obtained with a history of diabetes mellitus 15.3%, a history of heart disease 21.3%, a history of hypertension 46.7%, abnormal lipid levels 8.7%, abnormal hematocrit levels 9.3%, abnormal leukocyte levels 24%, and obesity nutritional status 15.3%. There is a relationship between a history of hypertension (p=0.0001), a history of DM (p=0.001), and a history of heart disease (p=0.001).

Conclusion: Hypertension is a dominant factor in the occurrence of non-hemorrhagic stroke. The public is expected to be more aware of various diseases related to the occurrence of non-hemorrhagic stroke.

INTRODUCTION

Stroke occurs due to lack of oxygen supply to the brain and causes nerve cell death. This brain dysfunction is what causes stroke (1). Stroke is the second leading cause of death worldwide and the number one cause of long-term disability, causing a global economic burden each year (2). Stroke occurs due to the cessation of blood supply to the brain due to blockage (Non-Hemorrhagic Stroke) or bleeding (Hemorrhagic Stroke). Non-hemorrhagic stroke is the main cause of disability and death and the occurrence of thrombolysis (3). Data from the Institute for Health Metrics and Evaluation (IHME) in 2019 showed that stroke was the leading cause of death in Indonesia (19.42% of total deaths). The prevalence of ischemic stroke or hemorrhagic stroke has the largest percentage, which is around 70% - 85% compared to hemorrhagic stroke of 15 - 30%. According to data from the Global Burden of Disease published in the last decade, the highest death and disability rates in the Southeast Asia region are in Indonesia (4). The prevalence of stroke in Indonesia has continued to increase since 2013 from 9% to 14.7% and the prevalence in Central Java is 3.8% (5). Based on data from the Banyumas Health Service, in the Banyumas area, there were 3,705 stroke patients recorded in 2022 and this increased to 4,423 in 2023. The dominant risk factors for stroke sufferers in Indonesia are increasing age, coronary heart disease, diabetes mellitus, hypertension, and heart failure (6). Identification of heart disease against stroke found atrial fibrillation as a risk factor for ischemic stroke (7). Ischemic stroke is caused by blockage of blood vessels in the brain in up to 80% of stroke cases (8). The study aimed to determine the differences in the proportion of leukocyte levels, hematocrit levels, nutritional status, heart history, history of diabetes mellitus, history of hypertension, and the incidence of non-hemorrhagic stroke.

METHODS

The research design uses a cross-sectional study. Study population patients with neurological diseases treated at Prof. Dr. Margono Soekarjo Purwokerto Regional Hospital. The research instrument used a checklist sheet based on patient medical record data from January to December 2023 in the Anyelir room (a special room for neurological patients). Sampling using a purpose sampling technique based on inclusion and exclusion criteria resulted in a sample of 102 respondents.

Univariate analysis on variables of gender, age, education level, history of stroke, and lipid levels in cases and controls with frequency distribution. Bivariate analysis, using the chi-square test ($\chi 2$), to determine the relationship between variables of heart history, history of Diabetes Mellitus, history of hypertension, leukocyte levels, hematocrit levels, and nutritional status with the incidence of non-hemorrhagic stroke. For variables with a p-value $\geq$ 0.25 in the bivariate analysis, binomial logistic regression was applied to identify the most dominant factors in the occurrence of non-hemorrhagic stroke. Hypothesis with a significance level of 5% and a 95% confidence interval. All data analysis was processed using SPSS Statistics for Mac, version 26.0 (SPSS Inc., Chicago, Ill., USA). This research ethics protocol was approved by the institutional committee of the School of Medicine and Health Sciences, Muhammadiyah University Purwokerto, No. KEPK/UMP/95/IV/2024

RESULTS

Table 1 shows the results of the incidence of non-hemorrhagic stroke, most of whom were women (52.9%), most of whom were of productive age (55.9%), most of whom had suffered a stroke for less than 2 years (88.2%), most of whom (88.2%) did not graduate from junior high school and most of whom had normal lipid levels (80.9%). **Table 2** shows the results of the incidence of non-hemorrhagic stroke, a greater proportion in patients with a history of diabetes mellitus (15.3%), a history of heart disease (21.3%) and a history of hypertension (46.7%), while a greater proportion in normal conditions was found in the normal hematocrit category (58.7%), normal leukocytes (44%) and normal nutritional status (52.7%). **Table 3** shows that there is a significant relationship between the incidence of non-hemorrhagic stroke with a history of diabetes mellitus (p=0.001), a history of heart disease (p=0.001)) and a history of hypertension (p=0.0001) and there is no relationship between the incidence of non-hemorrhagic stroke with hematocrit levels (p=0.104) leukocytes (p=0.379) and nutritional status (p=0.065) and hypertension is the most dominant factor as a cause of non-hemorrhagic stroke (**Table 4**)

Table 1. The Characteristics of Subjects

No.	Subject Characteristics	Yes n	Yes %	No n	No %
1	Gender				
	Male	32	47,1	15	44,1
	Female	36	52,9	19	55,9
2	Age category				
	Productive	38	55,9	32	94,1
	Not Productive	30	44,1	2	5,9
3	History of Stroke				
	$\leq$ 2 years	60	88,2	-	-
	> 2 years	8	11,8	-	-
	No history	0	-	34	100
4	Education level				
	$\geq$ Junior high school	8	11,8	16	47,1
	< Junior high school	60	88,2	18	52,9
5	Lipid level				
	Normal	55	80,9	-	-
	Abnormal	13	19,1	-	-

Table 2. Differences in The Proportion of Non-Hemorrhagic Stroke Risk Factors

No.	Risk Factors	Category	Yes n	Yes %	No n	No %
1	History of Diabetes Mellitus	No	46	52,7	33	26,3
		Yes	22	15,3	1	7,7
2	History of Heart Disease	No	39	46,7	31	23,3
		Yes	29	21,3	3	10,7
3	History of Hypertension	No	9	31,3	23	10,7
		Yes	59	46,7	11	23,3
4	Hematocrit Level	Normal	56	58,7	32	29,3
		High	12	9,3	2	4,7
5	Leukocyte Level	Normal	46	44,0	20	22,0
		High	22	24,0	14	12,0
6	Nutritional Status	Normal	49	52,7	30	26,3
		Obesity	19	15,3	4	7,7

Table 3. Risk Factors of Non-Hemorrhagic Stroke

No.	Risk Factors	X²	RP	p	95% CI Lower	95% CI Upper
1.	History of Diabetes Mellitus	9,606	15,783	0,001	0,011	0,996
2	History of Heart Disease	10,524	7,684	0,001	0,023	0,466
3	History of Hypertension	28,693	13,707	0,0001	0,028	0,315
4	Hematocrit Level	1,749	3,429	0,104	-	-
5	Leukocyte Level	0,435	0,683	0,379	-	-
6	Nutritional Status	2,533	2,908	0,065	-	-

Table 4. Dominant Risk of Non-Hemorrhagic Stroke

Risk Factors	Exp(B)	Lower	Upper
History of Diabetes Mellitus	.105	.011	0.996
History of Heart Disease	.104	.023	0.466
History of Hypertension	.095	.028	0.315

DISCUSSION

Most respondents were female. Risk factors for women suffering from stroke are higher, especially in the use of hormonal, obesity, eclampsia, and gestational diabetes. 1 in 5 women will have a stroke during their lifetime compared to 1 in 6 in men (9). Stroke cases with hypertension and hyperlipidemia occur more frequently in middle-aged men, but at the age of 65 years it is more common in women, as in the case of diabetes, this is because atrial fibrillation continues to increase with age in both sexes, but is more common in women in all age groups.

Stroke cases with hypertension and hyperlipidemia are more common in middle-aged men, but at the age of 65 years it is more common in women, as in the case of diabetes, this is because atrial fibrillation continues to increase with age in both sexes, but is more common in women in all age groups. Lifestyle factors are the main factors causing stroke and coronary heart disease (10). The results of the study showed that the percentage of strokes in productive age is higher, this is due to one of the lifestyle changes today, both in terms of physical activity and diet. As the results of previous studies, there is a tendency for strokes to be suffered by patients under 40 years old, especially young modern urban people (11). Statistically, there is no relationship between age factors and cases of non-hemorrhagic stroke (12), However, during 17 years of observation, the risk of recurrence and death was higher in younger patients (13). Recurrent stroke can occur in the same or different areas of the brain and uncontrolled risk factors are the cause of recurrent stroke and the predictor of recurrence in the majority of non-hemorrhagic stroke cases. Currently, there is a higher tendency for non-hemorrhagic stroke cases compared to hemorrhagic strokes. Several studies have shown that the majority of stroke patients are non-hemorrhagic strokes (87.7%) and the rest are hemorrhagic strokes (12.3%). The same findings as the study by Dermici

that 81% of 143 recurrent stroke patients were ischemic strokes (14). The use of a pediatric classification system provides new insights into the possible causes of cryptogenic stroke and has the potential to lead to more tailored treatments for young individuals with stroke. Risk Factors and Causes of Ischemic Stroke in 1322 Young Adults (15). The research results show the phenomenon of stroke occurring at the age of <35 years (16).

The results of the study showed that most cases of non-hemorrhagic stroke with low education, this shows that education is expected to increase knowledge about stroke so that early treatment of stroke can be done correctly. This study is in line with previous studies that low education can prolong the delay in going to the hospital when stroke symptoms occur (17). Length of education is inversely related to the incidence of non-hemorrhagic stroke (18).

The results of the study showed that 15% of the history of diabetes mellitus the occurrence of non-hemorrhagic stroke, this occurs because high blood sugar levels can cause blockages and fat deposits in the blood vessels, when blood vessels are blocked, and the oxygen supply from the blood to the brain will be disrupted so that stroke occurs. Increased blood sugar levels are positively correlated with the risk of stroke (the higher the blood sugar levels, the easier it is to have a stroke) (9). The results of the study showed that there was a significant relationship between diabetes mellitus and the incidence of stroke (19). Diabetes can cause stroke if blood sugar levels are not controlled properly, high blood sugar levels can cause blockages and fat deposits in blood vessels. causing the supply to the brain to be disrupted, then it can cause stroke. The same is true with hypertension which has the effect of accelerating the process of atherosclerosis which is at risk of causing blockages. High cholesterol deposits will be the trigger for atherosclerosis (20). Research showed consistent results, with the finding that 71.21% of ischemic stroke sufferers with DM and diabetes mellitus were risk factors for ischemic stroke (21). The cause of diabetes mellitus in cases of non-hemorrhagic stroke is due to progressive damage to the endothelium of blood vessels. If the insulin is not enough or cannot be used properly, the body loses the ability to process glucose or the body is unable to metabolize carbohydrates normally. As a result, glucose collects in the blood until it passes the threshold and comes out with urine, which is one of the signs of diabetes mellitus (22).

There is a difference in the proportion of history of heart disease in patients with non-hemorrhagic stroke (21.3%) and non-stroke 10.7%. The risk of non-hemorrhagic stroke is 7.684 times in respondents with a history of heart disease. Heart disease that often triggers stroke is heart rhythm disturbances due to the heart valve not closing properly, causing blockage. The risk of stroke in patients with a history of heart disease, especially after ring installation, is the presence of small emboli that are released into the brain which can then cause blockage. While coronary heart disease has a greater risk of cerebral infarction if accompanied by other risk factors (23). Irregular blood flow can risk slowing the formation of blood clots, then these blood clots can reach the brain and restrict blood flow to the brain, causing non-hemorrhagic strokes. Heart rhythm disturbances are the main risk factors for cardioembolic stroke. Atrial fibrillation significantly

increases the risk of stroke (9). Coronary Heart Disease carries a serious risk of stroke and systemic embolism, real complications that substantially impact the morbidity and mortality of adult congenital heart disease (24).

History of hypertension has a high risk of non-hemorrhagic stroke, the results of the study showed a difference in proportion, 46.7% of non-hemorrhagic strokes with a history of hypertension. Respondents who have a history of hypertension have a risk of stroke 13.707 times higher than respondents who do not have a history of hypertension. Hypertension can cause an increase in peripheral blood pressure so that a poor hemodynamic system occurs, then there is thickening of the blood vessels and hypertrophy of the heart muscle. Hypertension will cause atherosclerotic plaque continuously, triggering stroke (25). Hypertension is the hardening of the walls of the arteries and causes the destruction of fat in smooth muscle cells, thus accelerating the process of atherosclerosis. Hypertension plays a role in the process of atherosclerosis through the effect of pressure on endothelial cells/inner layer of the artery wall which results in the formation of blood vessel plaque more quickly. A person is said to be hypertensive if their blood pressure is 140/90 mmHg or more (26). Previous studies have shown a significant relationship between hypertension and stroke (p=0.035; OR=7.5). High blood pressure accelerates the hardening of the walls of the arteries and causes the destruction of fat in smooth muscle cells, thus accelerating the process of atherosclerosis (27). Hypertension is a significant risk factor for vascular disease including atherosclerosis of the cerebrovascular arteries and causes blockage (28). Hypertension and diabetes mellitus are risk factors for stroke and are correlated in patients with atherosclerosis (29).

The results of the study showed a tendency for abnormal lipid levels in patients with non-hemorrhagic stroke. Hyperlipidemia dyslipidemia or high cholesterol can cause blockages in the arteries where blood flows to the body. This can damage organs that do not receive enough blood flow from the arteries. Bad cholesterol (LDL) carries cholesterol from the liver into cells. If the amount of LDL is high, it can cause cholesterol to accumulate in cells which will trigger atherosclerosis. Blood will have more difficulty passing through, so there is a risk of stroke or heart attack. Inflammation of the plaque can cause clots to form around it. So it can cause stroke or heart attack depending on where the blockage is located (9).

There is a difference in the proportion of high hematocrit levels of 9.3% in non-hemorrhagic stroke respondents and 4.7% in non-stroke case respondents, although statistically not significant. Abnormal hematocrit levels (>46%) will cause increased blood viscosity or thickness it can reduce blood flow to the brain and risk non-hemorrhagic stroke. Changes in hemostasis or blood viscosity due to various causes such as increased hematocrit can increase the possibility of infarction expansion and worsening prognosis (30). Increased hematocrit will increase blood viscosity and there is an inverse relationship between viscosity and cerebral blood flow. Low cerebral blood flow with high viscosity results in reduced oxygen use by brain tissue (31).

The difference in the proportion of high leukocyte levels (24.5%) of non-hemorrhagic stroke respondents and 12% in non-stroke cases statistically shows no significant relationship between high leukocytes and the incidence of non-hemorrhagic stroke. This is not in line with previous studies which concluded that there was a moderate correlation (correlation coefficient of 0.465) between the number of leukocytes and the severity of stroke (32). In the pathophysiology of acute ischemic stroke including the release of inflammatory mediators, microcirculation obstruction, and vasoconstriction, leukocytes play an important role in alleviating clinical status and symptoms. Leukocytosis is a normal response to infection or inflammation. High leukocyte activity in stroke can induce more extensive cell death in the brain. The results of the study concluded that leukocytosis affects the clinical outcome of ischemic stroke patients with a p Of 0.026 (33).

The results of the study showed a difference in the proportion of obesity nutritional status of 15.3% of non-hemorrhagic stroke respondents and 7.7% of non-stroke respondents, although statistically, it did not show a significant relationship. A person who is obese will experience excess fat in the body, and if there is excess fat in the body it can cause the blood to be thicker and the blood vessels will become hard so that the blood vessels will be more easily ruptured and more easily blocked so that it can cause a non-hemorrhagic stroke. Obesity has a risk of developing vascular diseases such as stroke, each unit increase will increase the risk of non-hemorrhagic stroke by 5%. The amount of adipose tissue and storage of inflammatory cells can cause atherosclerosis. Several studies have shown that obesity can be affected by mild non-hemorrhagic stroke due to small blood vessel occlusion with better functional results, which means that these patients have a lower risk of mortality (34). The results of previous research showed that there was a relationship between obesity and risk factors for non-hemorrhagic stroke (p=0.001, OR: 4.251), meaning that obese respondents had a 4 times greater chance of having a stroke (35). The limitations of this study, are that it uses secondary data, there is incomplete data, one of which is lipid levels, in patients who do not have strokes, and no examination related to lipid levels was carried out.

CONCLUSION

The results of the study showed differences in the proportion of variables of heart history, history of DM, history of hypertension, leukocyte levels, hematocrit levels, and nutritional status with the incidence of non-hemorrhagic stroke. History of Diabetes Mellitus, Hypertension, heart disease are dominant factors in the occurrence of non-hemorrhagic stroke. The public is expected to be more aware of various diseases that are dominant factors in the occurrence of non-hemorrhagic stroke.

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