p-ISSN 2086-6380, e-ISSN 2548-7949

Jurnal Ilmu Kesehatan Masyarakat (JIKM)

RISK FACTOR ANALYSIS FOR STROKE INCIDENCE IN NORTH SULAWESI: BASED ON THE 2018 INDONESIA BASIC HEALTH RESEARCH

Lia Mulyani[1], Avliya Quratul Marjan[2*], Firlia Ayu Arini[3], Yessi Crosita Octaria[4]
[1,2,3,4] Fakultas Ilmu Kesehatan, Universitas Pembangunan Nasional "Veteran" Jakarta, 12450, Jakarta, Indonesia
Correspondence Author: avliyaquratul@upnvj.ac.id

ARTICLE INFO

Article History:

Received : March 05, 2023

Accepted : April 26, 2024

Published: April 29, 2024

DOI:

https://doi.org/10.26553/jikm.2024.15.1.70-84

Available online at

http://ejournal.fkm.unsri.ac.id/index.php/jikm

ABSTRACT

Stroke is a serious public health issue and the main cause of disability and death after ischemic heart disease. Every year, 12.2 million individuals worldwide suffer from a stroke, which results in 6.5 million deaths. There has been an increasing incidence of stroke in Indonesia, including in North Sulawesi. This study aims to examine the risk factors for stroke incidence in North Sulawesi in a population aged ≥35 years based on the 2018 Indonesia Basic Health Research data. This quantitative research was an analytical observational study with a cross-sectional design. The Chi-square test and multiple logistic regression were performed during data analysis involving 7,111 respondents. The multivariate analysis results showed that hypertension (p=0.000; AOR 8.739; 95% CI 5.758-13.263), physical activity (p=0.000; AOR 2.771; 95% CI 1.944-3.948), gender (p=0.000; AOR 2.047; 95% CI 1.388-3.017), heart disease (p=0.015; AOR 1.919; 95% CI 1.133-3.250), age (p=0.008; AOR 1.669; 95% CI 1.144-2.434), occupation (p=0.008; AOR 1.693; 95% CI 1.145-2.504), and fatty foods consumption (p=0.023; AOR 0.603; 95% CI 0.390-0.932) had a significant correlation with stroke incidence in this study. The main finding of this study shows that hypertension is the most influential risk factor for stroke incidence in a population aged ≥35 years in North Sulawesi. Regular blood pressure screenings are needed as an early hypertension detection effort to prevent stroke incidence.

Keywords: hypertension, risk factors, basic health research, stroke

Introduction

Stroke is the world's second-largest cause of mortality and the top cause of disability.[1] The World Stroke Organization (WSO) in 2020 reported that 12.2 million people worldwide suffer from stroke, resulting in 6.5 million deaths annually.[1] Stroke is a serious health issue in Asia, particularly in developing countries, including Indonesia. Asia is known to have a higher stroke death rate than Europe and North America.[1,2] Stroke is defined by the World Health Organization (WHO) as a disorder characterized by the fast development of numerous clinical indicators due to focal or worldwide neurological dysfunction lasting longer than 24 hours or culminating in death, with no obvious cause other than vascular (blood vessel) origin.[1]

Stroke incidence in Indonesia has risen from 7.0‰ in 2013 to 10.9‰ in 2018, according to the Indonesia Basic Health Research (*Riset Kesehatan Dasar* or Riskesdas).[2] The incidence of stroke also increased in several provinces in Indonesia, including North Sulawesi. In 2018, stroke incidence in North Sulawesi was 14.2‰, a 3.4‰ increase compared to 2013 (10.8‰). In 2013, North Sulawesi had the highest stroke incidence rate in Indonesia, while in 2018, the rank shifted to third position after East Kalimantan and the Special Region of Yogyakarta.[2,3] Apart from potentially causing disability or death to sufferers, stroke is also associated with a decline in health status, quality of life, and an increase in healthcare costs.[4] According to a report released by the healthcare and Social Security Agency (*Badan Penyelenggara Jaminan Sosial* or BPJS Kesehatan), stroke is ranked third among diseases with high healthcare costs, after heart disease and cancer. In 2020, the total cost spent on stroke healthcare services reached 2.5 trillion rupiah.[5]

When a stroke occurs, blood flow in the brain is disrupted, leading to cell death due to inadequate blood and oxygen supply. Based on the type of cause, stroke can occur due to blockage in blood vessels (ischemic stroke) or bleeding in the brain blood vessels (hemorrhagic stroke).[6] Previous research has shown that stroke is a multifactorial disease.[7] Overall, stroke causes are classified as modifiable and non-modifiable risk factors. Age, gender, race, and family history (genetics) are non-modifiable risk variables. Modifiable risk factors include hypertension, obesity, hyperlipidemia, type 2 diabetes, cardiac disease, smoking, alcohol intake, and sedentary lifestyle.[8,9]A case-control study conducted in 32 countries (Interstroke Study) showed that predictor variables of stroke include a history of hypertension, diabetes mellitus, cardiac causes, physical activity, dietary intake, Waist-to-Hip Ratio (WHR), smoking, and alcohol consumption. These risk factors are associated with the occurrence of both ischemic and hemorrhagic strokes.[7]

Stroke is typically found in the adult age group, but the risk doubles after the age of 55 years old.[10]Additionally, research conducted by Ghani et al. found that the risk of stroke jumps 5.8 times higher after the age of 55 years old.[11] Generally, studies indicate a higher incidence of stroke in men, but in terms of stroke mortality rates, women over the age of 75 years are found to be more dominant than men.[12] One of the reasons for the higher stroke mortality rate in women is related to

their higher life expectancy, with 60% of stroke-related deaths occurring in individuals over the age of 75 years old.[12] Based on the 2018 Riskesdas report, people aged 35-44 years have a three-fold higher incidence of stroke than those aged 15-34 years, and the risk continues to increase with age.[2]

The stroke incidence is influenced by health conditions related to non communicable diseases. Patients with comorbid hypertension have a 6.18-fold higher risk of stroke than patients without hypertension. Meanwhile, patients with a history of diabetes mellitus have a 4.12 times higher risk of stroke compared to patients without diabetes mellitus.[13] Individuals with other comorbidities such as coronary heart disease and heart failure are known to have a 2-3 times higher potential for stroke compared to individuals without these medical conditions.[11] In addition to non-communicable diseases, the nutritional status of obesity also found to be associated with stroke incidence. Obese patients are known to have a 4.9-fold higher likelihood of stroke compared to non-obese patients.[14] These findings are also consistent with research results from the Neurology Clinic of Dr. Pirngadi Hospital, Medan, which found a relationship between obesity and stroke incidence.[15]

Studies related to health behavior or lifestyle also indicate an association with stroke occurrence. A meta-analysis study involving 14 researchers concluded that, overall, smokers and former smokers are potentially 1.61 times more likely to experience stroke, contrasting with individuals who have never smoked.[16] Other health behavior risk factors correlated with stroke incidence include alcohol consumption and risky dietary intake. A meta-analysis study in 2016 found a relationship between consuming alcohol in large amounts (>4 times per day) and increased stroke risk, with a relative risk value of 1.08–1.14.[17] Risky dietary intake is indirectly associated with stroke incidence, contributing as a risk factor for non-communicable diseases that can increase stroke risk.[18]

The high prevalence of stroke in North Sulawesi is suspected to be caused by the high prevalence of obesity in North Sulawesi, which is the highest in Indonesia (30.2%), according to the 2018 Riskesdas report.[2] Additionally, the prevalence of hypertension in North Sulawesi is also categorized as high, at 33.12%.[2] One possible cause of this high prevalence is suspected to be related to the consumption of high-fat foods. A study conducted by Thamrin et al. showed that people living in eastern parts of Indonesia, such as Sulawesi, Bali, and Nusa Tenggara, tend to consume high-fat foods, thus increasing the risk of obesity.[19] Based on the National and Sub-National Disease Burden Analysis report for Indonesia in 2017, stroke remains a major cause of death in Indonesia.[20]

The 2018 Riskesdas report noted that the proportion of stroke patients in the age range of 35 to 44 years is three times higher than the age group of 15-34 years old.[2] Due to the high prevalence of Stroke in North Sulawesi from 2013-2018 makes this research crucial. The risk of stroke increases with aging populations, hence a deeper comprehension of the risk factors associated with

this region.[2,3] The study aims to uncover novel insights into the predominant risk factors contributing to stroke incidence within the population in North Sulawesi. By concentrating on individuals aged 35 years and above in the specific region, the study endeavors to reveal risk elements pertinent to this specific demographic and regional context. The study also extends its analysis to multivariate analysis, in order to offer a deeper understanding and pave the way for the development of targeted and effective prevention strategies in the future. The objective of the study is to examine the risk factors for stroke incidence in a population aged ≥35 years old in North Sulawesi based on the 2018 Indonesia Basic Health Research data.

Methods

This quantitative research was an analytical observational study incorporating a cross-sectional design. The independent variables were divided into three groups: respondent characteristics (age, gender, education, occupation, residential area, and obesity status), the history of non-communicable diseases (hypertension, diabetes mellitus, and clinically diagnosed heart disease), and health behavior (smoking habit, physical activity, and risky food, alcohol, and fruit and vegetable consumption). Moreover, the dependent variable was the history of clinically diagnosed stroke. This study used secondary data from the 2018 Riskesdas - a nationally representative large-scale survey conducted every five years by the Health Development Policy Agency of the Indonesian Ministry of Health (MoH), covering 34 provinces in Indonesia. The survey aims to collect data on various aspects of population health, including infectious diseases, non-communicable diseases, maternal and child health, nutritional status, health behaviors, and access to healthcare in Indonesia.

This study's participants consisted of a population aged ≥35 years in North Sulawesi in 2018 who met the inclusion criteria. The inclusion criteria include respondents aged ≥35 years old, having stroke-related data, a history of hypertension based on a medical doctor's diagnosis, weight and height measurements, and blood pressure data (the measurement was taken twice). In contrast, the exclusion criteria were respondents with extreme BMI values. The total sample obtained after the selection process was 7111 respondents (figure 1). The data collection process for the 2018 Riskesdas was divided into three types: interviews, examinations, and measurements. All variables in this study were collected through interviews, except for weight and height measurements (anthropometric measurements) and blood pressure examination (the blood pressure measurement was taken twice).

Before conducting data analysis, each variable was categorized according to the operational definitions of the study. The dependent variable stroke based on the doctor's diagnosis, it was categorized as yes or no. Age was grouped into 2 categories: (≥55 years old and 35-54 years old) based on the age grouping in the Riskesdas 2018 data, gender as male and female, education as

high (high school or more) and low (under high school), employment status as employed and not employed, residence as rural and urban, obesity (BMI > 27 kg/m2), hypertension based on doctor's diagnosis as yes and no, hypertension based on measurement (average of measurements 1 and 2 systolic ≥140 mmHg or diastolic ≥90 mmHg), diabetes mellitus and heart disease based on doctor's diagnosis as yes and no, history of smoking in the past month as yes and no, consumption of risky foods categorized as rare (<3 times a month) and frequent (≥1 time/day or 1-6 times/week), alcohol consumption as yes and no, consumption of fruits and vegetables as sufficient (≥5 servings/day) and insufficient (<5 servings/day), and physical activity as sufficient (≥600 MET minutes) and insufficient (<600 MET minutes) based on the Global Physical Activity Questionnaire (GPAQ).

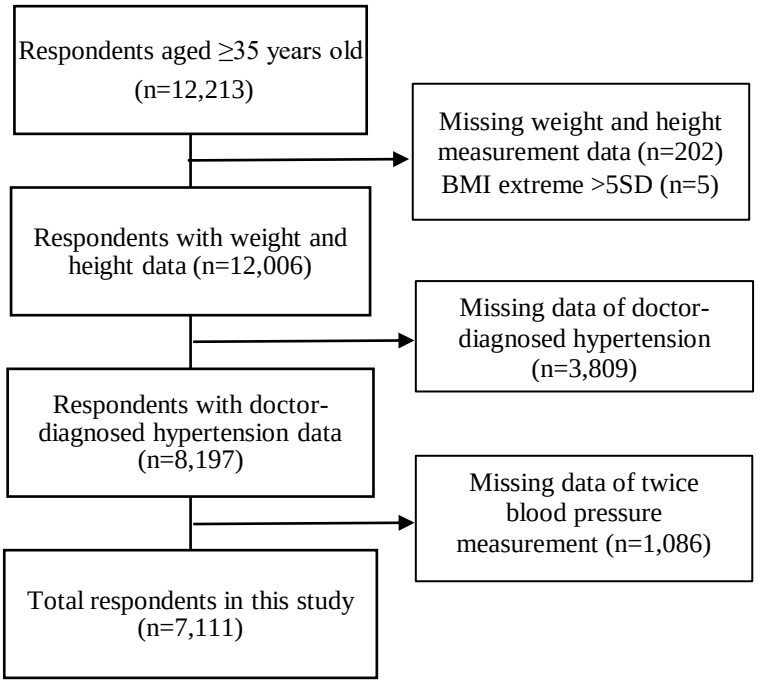

Figure 1 Subject Determination

Three types of data analysis carried out in this study. The descriptive analysis is used to describe the number and percentage of all variables researched, both independent and dependent variables. A bivariate analysis was performed to identify the association between stroke with all the independent variables using a chi-square test with a 95% confidence interval. A p-value of <0.05 was determined to be statistically significant. A multivariate analysis was also performed to find out the relationship of more than one independent variable with the dependent variable. The statistical test used was multiple logistic regression, considering that the dependent variable was categorical. Based on the results of this multivariate analysis, it was also evident which independent variable had the greatest influence on stroke incidence among individuals aged ≥35 years in North Sulawesi. The study has been approved by the Health Research Ethics Committee of Universitas Pembangunan Nasional "Veteran" Jakarta under No. 193/V/2023/KEPK.

Results

The results (Table 1) shows that the incidence of stroke in North Sulawesi in a population aged ≥35 years was 2.6%. The majority of respondents in this study were aged 35-54 years (60.6%), female (56.6%), had a low education level (61.9%), were employed (61.6%), and lived in rural areas (59.1%). A total of 36.4% of respondents were obese, had hypertension based on a medical doctor's diagnosis (28.5%), had hypertension based on blood pressure measurements (46.3%), had a history of diabetes mellitus (6.2%), and had a history of heart disease (3.6%). Regarding health behavior, it was found that the majority of male respondents were smokers (72.6%), had adequate physical activity (83.3%), consumed risky foods (sweet foods, sweetened beverages, salty foods, and fatty foods), consumed alcohol (28.5%), and were still lack of fruit and vegetable intake (75.2%).

Table 1. Respondent Characteristics (Univariate Analysis)

Variables	Frequency (n)	Percentage (%)
Stroke		
Yes	182	2.6
No	6,929	97.4
Age		
≥55 years	2,802	39.4
35 – 54 years	4,309	60.6
Gender		
Men	3,085	43.4
Women	4,026	56.6
Education		
Low	4,404	61.9
High	2,707	38.1
Occupation		
Unemployed	2,728	38.4
Employed	4,383	61.6
Residence		
Urban	2,908	40.9
Rural	4,203	59.1
Obesity status		
Yes	2,585	36.4
No	4,526	63.6
Hypertension (diagnosis)		
Yes	2,029	28.5
No	5,082	71.5
Hypertension (measurement)		
Yes	3,291	46.3
No	3,820	53.7
Diabetes melitus (diagnosis)		
Yes	439	6.2
No	6,672	93.8
Heart disease (diagnosis)		
Yes	255	3.6
No	6,856	96.4

Table 2. Respondent Characteristics (Univariate Analysis)

Variables	Frequency (n)	Percentage (%)
Smoking		
Men		
Yes	2,240	72.6
No	845	27.4
Women		
Yes	336	8.3
No	3,690	91.7
Physical Inactivity		
Yes	1,189	16.7
No	5,922	83.3
Risky food consumption		
Sweet foods		
Often	6,246	87.8
Seldom	865	12.2
Sweet beverages		
Often	6,358	89.4
Seldom	753	10.6
Salty foods		
Often	2,421	34.0
Seldom	4,690	66.0
Fatty foods		
Often	6,416	90.2
Seldom	695	9.8
Alcohol consumption		
Men		
Yes	878	28.5
No	2,207	71.5
Women		
Yes	69	1.7
No	3,957	98.3
Fruits and vegetables consumption		
Insufficient	5,348	75.2
Sufficient	1,050	14.8

Based on the data presented in Table 2, it shows that the respondent characteristics variables correlated with stroke in a population aged ≥35 years in North Sulawesi. Those characteristics include age, education level, and occupation. All variables related to non-communicable diseases (include hypertension, diabetes mellitus, and heart disease) were significantly correlated with stroke. Physical activity, consumption of risky foods, and alcohol consumption variables in male respondents also significantly correlated with stroke incidence in this study.

Table 3: Risk Factors Related to Stroke (Bivariate Analysis)

Variables	Stroke		No Stroke		P-Value	OR (95% CI)
	n	%	n	%		
Aged						
35-54 years	53	1.2	4,256	98.8	**<0.0001***	3.875 (2.805-5.355)
≥55 years	129	4.6	2,673	95.4		
Gender						
Men	89	2.9	2,996	97.1	0.148	-
Women	93	2.3	3,933	97.7		
Education						
High	51	1.9	2,656	98.1	**0.006***	1.597 (1.151-2.214)
Low	131	3.0	4,273	97.0		
Occupation						
Employed	83	1.9	4,300	98.1	**<0.0001***	1.951 (1.451-2.622)
Unemployed	99	3.6	2,629	96.4		
Residence						
Rural	103	2.5	4,100	97.5	0.534	-
Urban	79	2.7	2,829	97.3		
Obesity status						
Yes	68	2.6	2,517	97.4	0.834	-
No	114	2.5	4,412	97.5		
Hypertension (diagnosis)						
Yes	147	7.2	1,882	92.8	**<0.0001***	11.26 (7.76 – 16.34)
No	35	0.7	5,407	99.3		
Hypertension (measurement)						
Yes	130	4	3,161	96	**<0.0001***	2.98 (2.15 – 4.12)
No	52	1.4	3,768	98.6		
Diabetes Melitus (diagnosis)						
Yes	31	7.1	408	92.9	**<0.0001***	3.28 (2.20 – 4.89)
No	151	2.3	6,521	97.7		
Heart Disease (diagnosis)						
Yes	21	8.2	234	91.8	**<0.0001***	3.73 (2.32 – 5.98)
No	161	2.3	6,695	97.7		
Smoking						
Yes	81	2.8	2,788	97.2	0.279	-
No	101	2.4	4,141	97.6		
Physical inactivity						
Yes	83	7.0	1,106	93.0	**<0.0001***	4.41 (3.274 – 5.951)
No	99	1.7	5,823	98.3		
Sweet foods						
Often	145	2.3	6,101	97.7	**0,001***	0.532 (0.368 – 0.769)
Seldom	37	4.3	828	95.7		
Sweet beverages						
Often	152	2.4	6,206	97.3	**0.013***	0.590 (0.396 – 0.880)
Seldom	30	4.0	723	96.0		
Salty foods						
Often	42	1.7	2,379	98.3	**0.002***	0.574 (0.405 – 0.813)
Seldom	140	3.0	4,550	97.0		
Fatty foods						
Often	144	2.2	6,272	97.8	**<0.0001***	0.397 (0.275 – 0.573)
Seldom	38	5.5	657	94.5		

*= statistically significant (P value <0.05)

Table 4: Risk Factors Related to Stroke (Bivariate Analysis)

Variables	Stroke		No Stroke		P-Value	OR (95% CI)
	n	%	n	%		
Alcohol Consumption						
Yes	15	1.6	932	98.4	0.053	-
No	167	2.7	5,997	97.3		
Fruits and vegetables consumption						
Insufficient	124	2.3	5,224	97.7	0.702	-
Sufficient	27	2.6	1,023	97.4		

*= statistically significant (P value <0.05)

Based on the findings of multivariate analysis with logistic regression (Table 3), variables correlated with stroke incidence include age, gender, occupation, clinically-diagnosed hypertension, a history of heart disease, physical activity, and consumption of fatty foods. Fruit and vegetable consumption in this study was found to be a confounding variable, so it was included in the multivariate modeling. Among these variables, clinically-diagnosed hypertension was found to have a predominant correlation in influencing stroke incidence in a population aged ≥35 years in North Sulawesi. Respondents with hypertension showed an 8.739 times higher risk of experiencing stroke compared to those without hypertension comorbidity (95% CI: 5.758-13.263).

Table 5. Logistic Regression (Multivariate Analysis)

Variables	Koefisien β	P-Value	Adjusted OR (95% CI)
Age			
35-54 years ≥ 55 years	0.512	0.008	1.669 (1.144 – 2.434
Gender			
Women Men	0.716	0.000	2.047 (1.388 – 3.017)
Occupation			
Employed Unemployed	0.527	0.008	1.693 (1.145 – 2.504)
Hypertension (diagnosis)			
No Yes	2.168	0.000	8.739 (5.758 – 13.263)
Heart disease (diagnosis)			
No Yes	0.652	0.015	1.919 (1.133 – 3.250)
Physical inactivity			
No Yes	1.019	0.000	2.771 (1.944 – 3.948)
Fatty foods			
Seldom Often	-0.506	0.023	0.603 (0.390 – 0.932)
Fruits and vegetables consumption			
Sufficient Insufficient	-0.110	0.624	0.896 (0.576 – 1.392)

Discussion

The result of the study shows that the incidence of stroke in North Sulawesi in a population aged ≥35 years old was 2.6%. Stroke is a condition commonly occurring in the elderly age group, but there was research indicating an increase in stroke prevalence in younger age groups. A study conducted by George et al. found a 35.6% increase in ischemic stroke prevalence in the 35–44-year-old age group. This study analyzed inpatient data from the National Inpatient Sample of the United States (US), comparing the prevalence of ischemic stroke patients between the periods of 2003–2004 and 2011–2012.[21] The increasing incidence of stroke in late adulthood is partly related to the increasing prevalence of cardiovascular disease risk factors, including hypertension, dyslipidemia, diabetes mellitus, obesity, and smoking.[21] These risk factors are commonly found in stroke patients at a younger age. Additionally, lifestyle factors such as smoking, alcohol consumption, sedentary behavior, and illicit drug use also play a role.[22]

The risk of stroke also increases with age, especially after 55 years old.[10] This study shows that respondents aged ≥55 were at 1.669 times greater risk than those aged 35-54 (95% CI: 5.758-13.263). These findings were consistent with Azzahra's study, which found that respondents aged ≥55 years in Yogyakarta had a 3.23-fold increased risk of getting a stroke than those aged <55 years.[23] Ghani et al.'s research also stated that respondents aged ≥55 years had a 5.8-fold increasing risk of stroke compared to those aged 15-54 years, based on the 2013 Riskesdas data analysis in Indonesia.[11] Age correlates with the incidence of stroke in terms of the aging process. The aging process makes blood vessels stiffer, where the endothelium thickens in the intima part. The endothelium thickening further causes the narrowing of the blood vessel's lumen, disrupting the brain blood flow and increasing the risk of stroke.[24] In this study, male respondents were at 2.047 times greater risk of experiencing stroke than females. A cross-sectional study on a 40-year-old Chinese population indicated that male respondents were 1.43 times more likely to have a stroke (95% CI: 1.39-1.47).[25] The association between gender and stroke is known to be influenced by age. Longer life expectancy and the protective effects of premenopausal estrogen hormones are believed to make females more at risk of having a stroke in older age compared to males, with higher mortality rates.[26,27,28]

The proportion of stroke among unemployed respondents was higher than among employed respondents. A significant correlation was found between the respondent's occupation and stroke incidence in North Sulawesi (AOR 1.693; 95% CI 1.145-2.504). A prospective study by Eshak et al.'s in a population aged 40-59 years in Japan showed a significant relationship between employment status and stroke incidence. Unemployed men and women had a stroke risk of 1.58 (95% CI: 1.18-2.13) and 1.51 (95% CI: 1.08-2.29), respectively.[29] Stroke and unemployment are closely associated with stress and depression, a tendency for a sedentary lifestyle, and negative social stigma, which leads to inappropriate coping strategies, such as smoking and alcohol

consumption, especially among men.[29]

Hypertension was discovered to be the leading risk factor for stroke in a ≥ 35-year-old population in North Sulawesi (OR 8.739; 95% CI 5.758-13.263). This finding is consistent with earlier studies that show hypertension to be the most influential risk factor for stroke incidence.[23,25,30] Hypertension was the predominant risk factor for stroke in Yogyakarta (OR 5.69; 95% CI 3.68-8.79) in a population aged ≥15 years, based on the 2018 Riskesdas data analysis.[23]A cross-sectional study in a ≥ 40-year-old Chinese population found that hypertension patients had a 3.2-fold increased risk of stroke after adjusting for other variables (95% CI: 3.09-3.32).[25]The higher risk of stroke in hypertensive patients was found in Africa, based on a multicenter case-control research conducted in 15 locations in Nigeria and Ghana (OR 30.84; 95% CI 11.37-83.61).[30] Hypertension causes the heart into work harder to pump blood throughout the body, improving the risk of heart disease. Additionally, continuous high blood pressure will burden the brain arteries, triggering the formation of aneurysms and may cause hemorrhagic stroke.[31] Hypertension is also known to contribute to the formation of atherosclerosis by causing endothelial dysfunction.[31]

A history of heart disease was found to be correlated with stroke in this study. Respondents with a history of heart disease are 1.919 times more likely to have a stroke than those without heart disease comorbidity (95% CI; 1.133-3.250). This finding was in line with research conducted in Finland by Kivioja et al. on a population aged 25-49 years, which found that respondents with cardiovascular disease have an 8.01 times greater risk of experiencing stroke (95% CI; 3.09-20.78).[32] According to a cross-sectional study in a Chinese population aged ≥ 40 years, respondents with heart disease had a 2.49 fold increased risk of stroke (95% CI; 2.40-2.59).[25] The mechanism of heart disease increases the risk of stroke closely depending on the type of heart disease. Patients with coronary heart disease (CHD) are more likely to have a stroke due to the development of atherosclerosis, obstructing the oxygen flow and nutrient-rich blood to the brain. Other abnormalities, such as heart valve disorders, atrial fibrillation, and heart enlargement, can cause blood clots to form, increasing the risk of an ischemic stroke due to the formation of thrombi or emboli.[33,34]

Variables related to lifestyle or health behavior were also significantly correlated to stroke incidence in this study. Respondents with low physical activity had a 2.771 fold increased risk of stroke (95% CI: 1.944-3.948). This finding aligned with a study by Zhang et al., which found that respondents with low physical activity had a 1.446 fold higher chance of having a stroke (95% CI: 1.011-2.068).[35] Furthermore, physical inactivity has closely associated with an increasing risk of obesity, which contributes to a decrease in high-density lipoprotein (HDL) levels, higher blood pressure, and insulin resistance, leading to metabolic syndrome.[27] Fatty food consumption was also found to have a significant correlation with stroke incidence. This finding was consistent with research conducted by Syauqy et al., which showed a significant association between fatty food

consumption and stroke incidence in a population aged ≥45 years, based on the 2018 Riskesdas data analysis in Indonesia.[36] The limitation of the study included its reliance on secondary data, which led to adjustments in sampling criteria and operational definitions, thereby restricting its ability to explore other factors that may have had a significant influence. Furthermore, the self-reported data may contain bias, especially in recalling past medical history and lifestyle behaviors. However, this is mitigated by trained enumerators who conduct data collection.

Conclusion

The results of this study indicate that there are several risk factors associated with stroke incidence in North Sulawesi, including age, gender, occupational status, hypertension, heart disease, physical activity, and fatty food consumption. Among these factors, hypertension emerged as the most dominant risk factor identified in this study. It is recommended for the community to have regular blood pressure checks for early detection of hypertension in an effort to prevent stroke. Additionally, it is advised to control other risk factors related to non-communicable diseases, such as diabetes mellitus and heart disease, by engaging in sufficient physical activity, maintaining normal body weight, and adopting healthy lifestyle behaviors.

Acknowledgement

The Authors would like to express gratitude to the Health Development Policy Agency (BKPK), Ministry of Health Indonesia for granting permission to use Riskesdas 2018 data for this study.

Funding

The authors declare that this study has no funding from other parties.

Conflict of Interest

The authors declare that we have no conflict of interest.

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