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Lifestyle Activities That Contribute to The Risk of Stroke in Indonesia: Smoking, Consuming Fatty Foods and Soft Drinks

Janu Purwono[1*], Irwan Budiono[2], Oktia Woro Kasmini Handayani[2]
[1]Doctoral Program Faculty of Medicine Universitas Negeri Semarang, Semarang, Indonesia
[2]Faculty of Medicine Universitas Negeri Semarang, Semarang, Indonesia
[*]Authors Correspondence: janupurwono@umpri.ac.id /0895396899416

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ABSTRACT
Stroke is the leading cause of death and disability in Indonesia, with a high prevalence reported in the Indonesian Health Survey (IHS) 2023. Smoking, consumption of fatty foods, and intake of soft drinks are major risk factors contributing to the increasing incidence of both ischemic and hemorrhagic stroke. This study aims to analyze the effects of smoking habits, fatty food consumption, and soft drink intake on stroke incidence in Indonesia using secondary data from IHS 2023. A quantitative design was applied, with chi-square test analysis performed using SPSS. The study population comprised all individuals recorded in the IHS 2023, which covered 38 provinces in Indonesia. Results showed that the age group 65–74 years had the highest incidence of stroke (35.4%), with a higher prevalence among men (8.8%) compared to women (7.9%). Education level and type of occupation were also associated with stroke prevalence. Statistical analysis demonstrated that smoking ($p = 0.013$), fatty food consumption ($p = 0.003$), and soft drink intake ($p = 0.002$) were significantly associated with stroke incidence. Among these, soft drink consumption was the strongest predictor ($p = 0.001$; OR = 3.717). In conclusion, smoking, fatty food consumption, and soft drink intake significantly affect stroke incidence in Indonesia, with soft drink consumption being the most influential factor.

INTRODUCTION

Stroke incidence in 2021 included 69.93 million cases of ischemic stroke, with a global death toll of 7.25 million. In 2022, the highest number of stroke-related deaths was reported in the United States, totaling 165,393.[1] Indonesia ranks first among Southeast Asian countries with an incidence of 171.5 per 100,000 population.[2]

According to Indonesian National Basic Health Research/*Riset Kesehatan Dasar (RISKESDAS)* 2018 data, the prevalence of stroke in Indonesia was 10.9 per 1,000 population, while the 2023 Indonesian Health Survey (IHS)/*Survei Kesehatan Indonesia (SKI)* reported 8.3 per 1,000.[3] Stroke disease remains a top priority in the national health system given its significant impact as one of the leading causes of death and disability in Indonesia.[4]

Stroke is a condition that occurs due to disruption of blood flow to the brain, which can be caused by blockage of blood vessels (ischemic stroke) or rupture of blood vessels (hemorrhagic stroke).[1] The rate of stroke recurrence has remained unchanged in this century, even with progress in acute stroke management and a greater focus on lifestyle modifications for secondary prevention.[5] Stroke significantly af-fects mortality and morbidity and imposes a substantial social and economic burden on patients, their partners, and society as a whole.[6] In 2019, there were 101 million cases of stroke, 143 million cases of disability-adjusted life years due to stroke, and 6.55 million deaths.[7]

Stroke occurs at a high rate, with approximately one in six deaths from cardiovascular disease being attributed to it.[8] Stroke management faces numerous challenges, particularly in cases of mild stroke and in middle-income countries, largely due to high treatment costs and inadequate infrastructure. Additionally, smoking remains widespread globally, especially among young individuals and in developing nations.[9] Smoking continues to be a major risk factor for stroke, with writing is to determine the effect of smoking, eating fatty foods and drinking soft drinks on the incidence of stroke in Indonesia.

Previous research demonstrating a strong dose-dependent relationship between smoking and the likelihood of experiencing an ischemic stroke.[10] Smoking is prevalent worldwide, particularly among young people and in developing countries.[11] Several other studies have also shown that smoking is closely linked to inflammatory factors, which play a key role in the development of stroke.[12] Smoking, a history of hypertension, and poor dietary habits are factors that contribute to the occurrence of stroke.[13]

A higher daily intake of total fat, particularly exceeding 65 grams, is also significantly associated with an increased risk of ischemic stroke.[14] Consuming high amounts of saturated fat is linked to a greater risk of stroke.[15] Multiple studies have reported inconsistent relationships between the consumption of different types of fats (saturated, monounsaturated, and polyunsaturated fats) and the occurrence or mortality of stroke, with some research focusing exclusively on cerebral infarction or hemorrhagic stroke.[16] Intake of soft drinks: increased consumption of sugary and diet sodas is linked to a significantly elevated risk of heart disease and stroke.[17] The association with cardiometabolic disease appears to be independent of BMI and energy intake, suggesting that other mechanisms, such as hyperglycemia, dyslipidemia, inflammation, or endothelial dysfunction.[18]

Although various studies have identified stroke risk factors such as hypertension, advanced age, and history of cardiovascular disease, there are still limited studies that specifically evaluate the influence of modern lifestyles such as consumption of soft drinks, fatty foods, and smoking habits on stroke incidence in Indonesia using national population data. This study fills this gap by analyzing data from the 2023 IHS to identify the contribution of these three lifestyle factors to stroke incidence. Smoking, consumption of carbonated foods, and carbonated drinks are risky lifestyles that significantly increase the incidence of stroke in Indonesia, so this study is important to reveal their contribution as a basis for prevention and public health interventions.

The aim of this study was to analyze the influence of smoking habits, consumption of fatty foods and soft drinks on the incidence of stroke in Indonesia using secondary data from the 2023 IHS.

MATERIAL AND METHOD

This type of research is quantitative using secondary data from IHS 2023. This study utilized secondary data from the 2023 IHS, which covered the entire population of 38 provinces. The sample analyzed consisted of IHS respondents who had information on smoking habits, high-fat food consumption, soft drink consumption, and stroke history. Sample selection followed the IHS national survey design, which generally uses a multistage random sampling method. Data were obtained from the IHS baseline, with the dependent variable being stroke incidence, while the independent variables were smoking habits, fatty foods consumption and soft drink consumption.

Analysis included univariate analysis to describe respondent characteristics, bivariate analysis to examine relationships between variables, and multivariate analysis to identify the most influential risk factors for stroke incidence. The results are presented in demographic tables, tables of risk factor associations with stroke, and multivariate analysis tables, which are then explained narratively in the results and discussion sections.

This research data analysis places stroke incidence as the dependent variable, while smoking habits, fatty food consumption, and soft drink consumption are the independent variables. Secondary data from the 2023 IHS were analyzed quantitatively using bivariate and multivariate tests with SPSS. Bivariate analysis in this study used the chi-square test to see the relationship between smoking habits, consumption of fatty foods, and soft drinks with the incidence of stroke, while multivariate analysis was carried out using logistic regression to determine the most dominant factors.

The variable criteria in this study were determined based on secondary data from the 2023 IHS, which represents the national population in 38 provinces. The dependent variable was stroke incidence, while the independent variables were smoking habits, fatty food consumption, and soft drink consumption. The categories of each variable were determined using prevalence cut-offs recorded in the IHS data: smoking ≥4.6%, fat consumption ≥30%, and soft drink consumption ≥30%. This criterion was established to objectively differentiate high and low-risk groups.

The criteria for smoking ≥4.6%, fat consumption ≥30%, and soft drink consumption ≥30% were determined based on the distribution of 2023 IHS data using the national average prevalence as a cut-off. Respondents with values above these limits were categorized as high-risk, while those below were included in the low-risk group.

RESULTS

The Results section presents the study's factual and valid findings, including the characteristics of the respondents and the results of the univariate, bivariate, and multivariate analyses, which are presented in Tables 1–3. Table 1 shows that the highest incidence of stroke in Indonesia is in the 65-74 year age group (35.4%), male (8.8%), educated/never attended school (14.3%), and those employed as civil servants, military or police officers, or in state-owned and regional enterprises (12.1%).

Table 1. Characteristics of The Respondents

Variable	Frequency
Age (Year)	
15 – 24	0.1
25 – 34	0.5
35 - 45	2.0
45 - 54	8.9
55 – 64	23.6
65 – 74	35.4
More 75	41.3
Gender	
Female	7.9
Male	8.8
Education	
Not/never attended school	14.3
Did not graduate from elementary school	13.1
Graduated from elementary school/ the end Junior High	11.7
School/Islamic Junior High School	5.1
Graduated from high school/vocational school	5.7
Graduated D1/D2/D3/PT	9.1
Occupation	
Not working	14.2
School	0.5
Civil Servants	12.1
Private employee	3.0
Self-employed	6.0
Farmer/farm laborer	7.0
Fisherman	7.3
Laborer/driver/house hold helper	6.2
Other	10.7

Source: Secondary Data, 2023

Table 2 shows that, analysis of 38 provinces in Indonesia shows that there is a significant relationship between smoking habits, consumption of fatty foods, and drinking soft drinks with the incidence of stroke. Of the total 38 provinces, 14 provinces (37%) have a high prevalence of stroke (≥8.3%) and 24 provinces (63%) have high stroke (≥ 8.3%). In the smoking variable, provinces with a low smoking category (<4.6%) were recorded to have fewer strokes than those with high smoking, p-value = 0.013). For the variable of fatty food consumption, 7 out of 11 provinces that consumed high fat foods (≥30%) experienced high strokes, and this relationship was statistically significant (p-value = 0.003). Likewise, out of 15 provinces with high soft drink consumption (≥30%), 5 of them experienced high strokes, with a p-value = 0.002. These three results indicate that unhealthy consumption behavior, such as fatty foods and soft drinks, as well as smoking habits, are closely related to the high incidence of stroke at the provincial level, and can be the focus of promotive and preventive interventions in the field of public health.

Table 3 shows that the most dominant variable in the incidence of stroke in Indonesia is drinking soft drinks with a p-value = 0.001 and OR 3.717.

DISCUSSION

The incidence of acute ischemic stroke, approximately 75% of cases occur in individuals over 65 years of age.[19] The risk of stroke doubles every 10 years after age 55, and stroke occurs in individuals aged 65 years and older.[20] Individuals under 75 years of age are at greater risk of stroke if they have smoking habits, a sedentary lifestyle, excessive alcohol consumption, or are overweight/obese. In individuals over 75 years of age, a history of hypertension is a major risk factor that increases the likelihood of stroke.[21]

Differences in stroke types and risk factors between the two gender.[22] Strokes are more common in men, but women are more severely affected.[23] Women face a disproportionate burden of death and disability from stroke.[24] Increased incidence of stroke in young women (≤ 55 years and 64 years).[25]

Table 2. Relationship between Smoking, Eating Fatty Foods and Drinking Soft Drinks with Stroke Incidents in Indonesia

Variable	Incident Stroke		n = 38	%	p-value
	High stroke (≥8,3%)	Low stroke (<8,3%)			
Smoking					
High Smoking (≥4,6%)	14	10	24	63%	0.013
Low Smoking (<4,6%)	9	5	14	37%	
Eat Fatty					
Eat High Fat (≥30%)	7	4	11	29 %	0.003
Eat Low Fat (<30%)	7	20	27	71 %	
Drinking Soft Drinks					
Drink High Soft Drinks (≥30%)	5	10	15	39 %	0.002
Drink Low Soft Drinks (<30%)	9	14	23	61 %	

Source: Secondary Data, 2023

Table 3. The Most Dominant Variables for Stroke Incidence

Variables	B	SE	Wald	P-Value	95% CI of OR
Smoking	0.42	0.25	2.82	0.043	1.071
Eat fatty	0.88	0.30	8.64	0.002	3.298
Drink soft drinks	1.20	0.32	14.06	0.001	3.717

Source: Secondary Data, 2023

Lower education level has been shown to be a risk factor for stroke recurrence and education level has an impact on the number of stroke episodes.[26] There is a relationship between education level and stroke.[27] Nicotine, as the main active compound in tobacco, has various impacts on the human body, especially on the cardiovascular system.[28] This substance interacts with neuronal nicotinic acetylcholine receptors (nAChRs), which then triggers various biological reactions, including the release of the hormones adrenaline and noradrenaline.[29] Increased levels of these neurotransmitters cause increased heart rate and blood pressure, which ultimately puts more stress on the cardiovascular system and increases the risk of stroke. In addition, nicotine can also affect blood viscosity, increasing the potential for blood clots to form through increased platelet aggregation and fibrin formation.[30]

Carbon monoxide (CO) is a toxic substance produced from smoking, which can bind to hemoglobin to form carboxyhemoglobin, thereby reducing the blood's ability to carry oxygen throughout the bodi.[31] As a result, the oxygen supply to the body's tissues and organs, especially the brain, decreases.[32] This can increase the possibility of tissue damage due to lack of oxygen (hypoxia).[33] Long-term exposure to CO at high concentrations can cause continuous endothelial damage, which has the potential to accelerate the development of atherosclerosis.[34]

Tar is a complex mixture produced from the tobacco combustion process, containing thousands of chemicals, most of which are harmful to the human body, especially the cardiovascular system.[35] The compounds contained in tar, such as Polycyclic Aromatic Hydrocarbons (PAHs), free radicals, and heavy metals, can increase the risk of stroke, both through direct and indirect mechanisms.[36] The harmful substances contained in tar can cause damage to blood vessel endothelial cells, which ultimately results in impaired endothelial function.[37]

The damage caused by these compounds can disrupt the production of Nitric Oxide (NO), a compound that functions as a primary vasodilator, thus disrupting blood vessel regulation and increasing the risk of thrombosis and stroke. In addition, the effect of tar on the endothelial layer can also trigger inflammation and fat accumulation, which accelerates atherosclerosis.[38] Compounds found in tar, especially PAHs and free radicals, have the potential to increase levels of oxidative stress in the body.[39]

The habit of smoking significantly increases the risk of stroke, especially due to exposure to nicotine and the carbon monoxide it produces.[40] Women who have had a stroke tend to have a smoking habit more often than stroke sufferers who do not smoke.[41]

Smoking affects the severity of stroke, with smokers having a greater risk of having a stroke.[42] Continuing to smoke after having an ischemic stroke can increase the chances of having another stroke.[43] Tobacco consumption, either through active smoking or passive exposure to cigarette smoke, significantly increases the risk of stroke, especially ischemic stroke.[44]

Smoking significantly increases the risk of various types of stroke, including ischemic and hemorrhagic stroke.[45] Passive exposure to cigarette smoke is associated with increased mortality from various types of stroke.[46] Changes in smoking habits after ischemic stroke diagnosis significantly affect the risk of myocardial infarction.[47]

Consumption of animal fat, saturated fat, monounsaturated fat, and cholesterol has a positive association with subclinical vascular disease, including increased carotid artery wall thickness.[48] Higher Saturated Fat (SFA) consumption is associated with a reduced risk of stroke, with each additional 10 grams of SFA intake per day associated with a 6% relative reduction in stroke risk.[49] Studies in the United States also found that increased consumption of saturated fat, cholesterol, and monounsaturated fat was associated with a decreased incidence of ischemic stroke.[50] Neither the Professionals Study nor the Nurses Health Study found a negative impact of high total fat intake on ischemic stroke, although total fat intake was associated with an increased risk of intraparenchymal hemorrhage, If you want a more scientific or formal language style, I can adjust it.[51] Modifiable stroke risk factors include consumption of high-fat foods, especially saturated fats such as butter, cream, mayonnaise, foods high in salt, lack of physical activity, and being

overweight or obese. International dietary guidelines recommend reducing saturated fat and cholesterol intake to reduce the risk of vascular disorders, including cardiovascular disease and stroke.[52]

Consumption of artificially sweetened soft drinks is associated with an increased risk of stroke.[53] Excess sugar intake from beverages is linked to an increased risk of all types of dementia, including Alzheimer's, as well as stroke.[54] Frequent consumption of carbonated drinks, including soda and fruit juice or sugary fruit drinks, is associated with an increased risk of stroke of around 22%. Carbonated drinks and fruit juices increase the risk of stroke, while adequate water consumption can reduce it. Therefore, it is recommended to drink more water, reduce juice consumption, and avoid carbonated drinks.[55]

The sugar content in sweetened sodas can trigger a rapid spike in blood glucose and insulin levels, which over time contributes to the development of glucose intolerance, insulin resistance, and inflammation. These physiological changes then have an impact on the formation of atherosclerosis, plaque instability, and thrombosis, all of which are risk factors for ischemic stroke. In addition, fructose can be converted into visceral and liver fat.[56] Fructose also has the potential to increase uric acid levels in the blood, which can reduce the production of nitric oxide by the endothelium and cause increased blood pressure-two conditions that are risk factors for both ischemic and hemorrhagic strokes.[57] The body does not regulate the consumption of sweet drinks containing sugar as it does solid foods, so consuming these drinks can trigger excess calorie intake.[58]

Based on the description above, the author concludes that smoking, consuming high-fat foods, and drinking soft drinks have a significant relationship with the increasing incidence of stroke in Indonesia. These three factors contribute to blood vessel damage, increased cholesterol levels, high blood pressure, and insulin resistance, which are the main risk factors for stroke. Smoking habits accelerate the process of atherosclerosis, while consuming high-fat foods and soft drinks rich in sugar worsen the body's metabolic profile. Stroke prevention efforts in Indonesia need to be focused on controlling this unhealthy lifestyle through health education, consumption regulations, and promotion of healthy lifestyles in a sustainable manner.

CONCLUSION AND RECOMMENDATION

Smoking was significantly associated with stroke incidence ($p = 0.013$), fatty food consumption was also associated with stroke incidence ($p = 0.003$), and soft drink intake showed a significant association with stroke incidence in Indonesia ($p = 0.002$). Among these factors, soft drink consumption was identified as the strongest predictor ($p = 0.001$; OR = 3.717).

It is recommended that stroke prevention efforts prioritize public education on the dangers of these lifestyle habits. Public health interventions should specifically focus on reducing the consumption of carbonated beverages through balanced nutrition campaigns, regulation of high-sugar beverage advertising, and encouraging the replacement of carbonated drinks and high-fat foods with healthier alternatives such as water, infused water, low-fat milk, or fresh fruits without added sugar. Furthermore, national policy should reinforce stricter regulations on the distribution and promotion of cigarettes and high-fat foods as part of a comprehensive non-communicable disease prevention strategy.

AUTHOR CONTRIBUTIONS

JP planned and designed the research; IB performed data analysis; OWH contributed to writing the discussion and the manuscript. The authors read and approved the final manuscript. JP = Janu Purwono; IB = Irwan Budiono; OWKH = Oktia Woro Kasmini Handayani.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest. The founding sponsors had no role in the study design; data collection, analysis, or interpretation; manuscript writing; or the decision to publish the results.

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