



# THE FEATURES OF COMORBIDITY OF STROKE IN THE INDONESIAN POPULATION: FINDINGS FROM THE INDONESIAN FAMILY LIFE SURVEY (IFLS-5)

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## ABSTRACT

**Background:** Comorbidities are associated with a worse stroke prognosis and more challenging clinical management. However, population-based research related to stroke comorbidities in Indonesia is still limited.

**Objective:** This study aims to evaluate the features of important comorbidities among stroke patients in the Indonesian population.

**Methods:** The data was taken from the 2014–2015 Indonesian Family Life Survey (IFLS-5), which represents 83% of the Indonesian population. Data were analyzed by means of logistic regression models using statistical software for data science (STATA) 13.

**Results:** There was a statistically significant relationship between stroke history and several comorbidities risk factors. The risk of stroke increases in individuals with hypertension (odds ratio (OR): 7.97, 95% confidence interval (CI): 5.19-12.26), diabetes (OR: 1.90, 95% CI: 1.14-3.15), heart disease (OR: 2.67, 95% CI: 1.47-4.85), and hyperlipidemia (OR: 3.68, 95% CI: 2.40-5.64). Of the 309 stroke patients, 41.9% had one comorbid condition; 24.1% had two; and 10.5% had three. Comorbidities increase with age, and 80.50% of stroke patients with comorbidities are aged 50 years or more.

**Conclusion:** This study showed that the most common comorbidities in stroke patients in Indonesia are hypertension, hyperlipidemia, and diabetes.

**Keywords:** comorbidity, hypertension, IFLS, Indonesia, stroke



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## Introduction

Stroke is the leading cause of death in Indonesia, with 131 deaths per 100,000 people.<sup>1</sup> The burden of stroke is not only limited to the morbidity that arises as a sequel but also to stroke comorbidities that have an impact on clinical and economic conditions. Comorbidity is a term used to describe the presence of a medical condition that coexists with the primary condition. Several studies have proven that comorbidity in stroke patients has a negative effect on long-term prognosis, both in terms of mortality and functional outcome.<sup>2,3</sup> Therefore, comorbidity needs to

be an important concern in relation to stroke outcomes in order to improve stroke-related health services.

This study aims to investigate the incidence and significance of comorbidities in stroke patients in Indonesia based on national survey data. Potential comorbidities that will be investigated for their relationship with stroke include hypertension, diabetes, heart disease, hyperlipidemia, and chronic obstructive pulmonary disease (COPD). Evaluation of comorbid conditions is expected to provide an important picture of the conditions and needs of stroke patients in various age groups so that the allocation of resources for stroke management can be carried out more efficiently.

## Methods

### Study Design and Subjects

The data was taken from the 5th wave of the Indonesian Family Life Survey (IFLS-5), which was collected in 2014–2015. IFLS uses a stratified sampling strategy at the provincial level, followed by random sampling at a lower level. IFLS data represents 83% of Indonesia's population regarding individual respondent data, families, communities, as well as health and education facilities used.<sup>4</sup>

Inclusion criteria for this cross-sectional analysis were those aged 18 years and over with complete chronic condition interview data based on IFLS-5 survey data. Exclusion criteria were under 18 years of age and incomplete chronic condition interview data.

### Variable Classifications

Demographic data, including age, gender, education, insurance ownership, smoking habits, and chronic medical conditions, was obtained through interviews. Participants were asked questions with yes or no answers, such as "Are you the policy holder/primary beneficiary of health benefits, health insurance...?" Chronic medical conditions are assessed with questions such as, "Did a doctor/paramedic/nurse/midwife ever diagnose you with (stroke, hypertension, diabetes, heart disease, hyperlipidemia, or COPD)?"

Nutritional status was measured using the body mass index (BMI), which is classified based on the Asia-Pacific perspective from the World Health Organization (WHO).<sup>5</sup> Weight was measured with a Camry model EB1003 scale, while height was measured with a Seca model 213 scale.<sup>4</sup> BMI was classified as underweight ( $<18.5 \text{ kg/m}^2$ ), normoweight ( $18.5\text{-}22.9 \text{ kg/m}^2$ ), overweight ( $23.0\text{-}24.9 \text{ kg/m}^2$ ), and obese ( $>25.0 \text{ kg/m}^2$ ).<sup>5</sup>

An abridged version of the International Physical Activity Questionnaire (IPAQ) over the previous seven days (IPAQ-S7S) was used to measure physical activity. The IPAQ scoring procedure divides physical activity into three categories: inactive, moderate, and active.

### Statistical Analysis

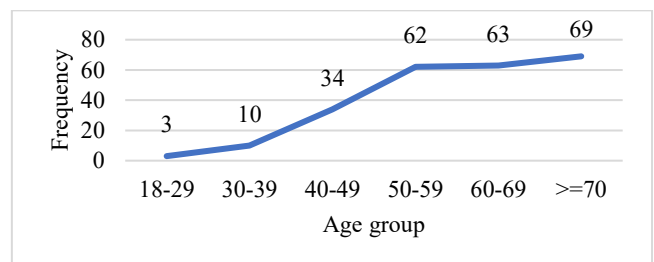
The history of a stroke served as the study's dependent variable. Independent variables include age, gender, education, insurance ownership, nutritional status, smoking habits, physical activity, and chronic comorbidities (hypertension, diabetes, heart disease, hyperlipidemia, and COPD). Stroke, insurance ownership, smoking habit, and chronic comorbidities were categorized as (1) yes and (2) no. Age was categorized as (1)  $<60$  years and (2)  $>60$  years. Education is categorized as (1) did not finish

elementary school, (2) elementary school, (3) junior high school, (4) senior high school, and (5) university. Nutritional status was categorized as (1) underweight, (2) normal, (3) overweight, and (4) obesity. Physical activity was categorized as (1) inactive, (2) moderate, and (3) active.

Statistical analysis used statistical software for data science (STATA) 13. The independent variables were presented in categorical form and expressed in percent (standard error). A descriptive analysis was conducted to assess the characteristics of the respondents. Differences between groups were analyzed using the chi-square test. Simple logistic regression was utilized in bivariate analysis. By adjusting for demographic and socioeconomic factors, multiple logistic regression was used to ascertain the significance of the influence of comorbidities on stroke. A  $p$ -value of 0.05 was used as a cut-off level of significance.

## Results

Based on IFLS-5 data, 31,879 respondents aged 18 and over were included in the study. There were 309 cases of stroke identified. Table 1 displays the respondents' characteristics. Based on our data, the majority of stroke respondents (55.9%) were aged 60 years and over, had education up to graduation from elementary school (52.9%), and were obese (57.3%). The sex ratio was close to equal, with insignificant differences between groups. Ownership of insurance among stroke respondents was 54.7%. Smoking habits were found in 41.2% of stroke respondents, and 88.1% engaged in strenuous activities. There were no significant differences between the stroke and non-stroke groups on smoking habits or physical activity. The highest prevalence of chronic comorbidities in stroke patients was hypertension (71.6%), followed by hyperlipidemia (25.7%), diabetes (14.6%), heart disease (12.4%), and COPD (4.3%). The frequency of stroke responders who experience comorbidities increases with increasing age (Figure 1). As many as 41.9% of respondents had 1 comorbidity (hypertension, diabetes, heart disease, hyperlipidemia, COPD) related to stroke; 24.1% had 2 comorbidities; 10.5% had 3 comorbidities; and 1.8% had 4 comorbidities.



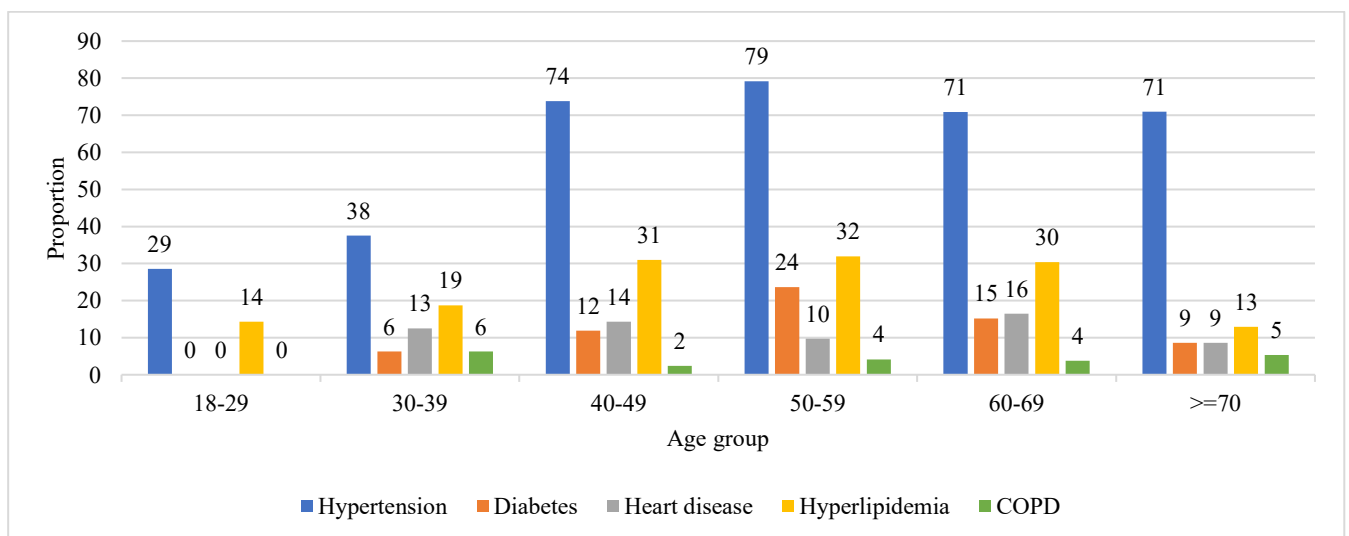
**Figure 1.** Frequency of stroke patients with comorbidities in each age group

The proportion of specific comorbidities by age group is shown in Figure 2. Hypertension predominated with an almost two-fold increase in the proportion from age 30 to 40, but the curve flattened at age 50 and over. Diabetes and hyperlipidemia have a

similar pattern, with a peak increase occurring in the years 50–59, then sloping and tending to decrease. Comorbid heart disease peaked in the 60–69 years of age, while the proportion of COPD did not change much from the age of 30 and over.

**Table 1.** Baseline variables compared by stroke in the Indonesian population

Variables	Stroke (+) n = 309 % (SE)	Stroke (-) n = 31,570 % (SE)	p-value	Total % (SE)
Age (years)			<0.01	
<60	44.1 (3.1)	85.8 (0.2)		83.8 (0.2)
≥60	55.9 (3.1)	14.2 (0.2)		16.2 (0.2)
Gender			0.60	
Male	49.7 (3.1)	48.1 (0.3)		48.5 (0.3)
Female	50.3 (3.1)	51.9 (0.3)		51.5 (0.3)
Education			<0.01	
Less than primary education	0.1 (0.1)	0.1 (0.0)		0.1 (0.0)
Elementary school	52.9 (3.2)	39.4 (0.3)		39.5 (0.3)
Junior high school	17.8 (2.4)	19.2 (2.4)		19.1 (0.3)
Senior high school	17.0 (2.4)	28.3 (0.3)		28.2 (0.3)
College	12.2 (2.1)	13.0 (0.2)		13.1 (0.2)
Insurance ownership	54.7 (3.1)	47.4 (0.3)	0.02	47.4 (0.3)
Nutritional status			<0.01	
Underweight	8.7 (1.7)	9.8 (0.2)		8.2 (0.2)
Normoweight	20.4 (2.5)	37.4 (0.3)		30.8 (0.3)
Overweight	13.6 (2.1)	16.0 (0.2)		13.3 (0.2)
Obese	57.3 (3.1)	36.8 (0.3)		47.7 (0.3)
Smoking	43.4 (3.1)	39.0 (0.3)	0.16	39.1 (0.3)
Physical activity			0.32	
Inactive	1.5 (0.9)	2.2 (0.1)		2.2 (0.1)
Moderate	10.4 (2.5)	14.1 (0.2)		14.1 (0.2)
Active	88.1 (2.6)	83.7 (0.2)		83.7 (0.2)
Chronic comorbidity				
Hypertension	71.6 (2.8)	13.9 (0.2)	<0.01	14.5 (0.2)
Diabetes	14.6 (2.2)	2.7 (0.1)	<0.01	2.8 (0.1)
Heart disease	12.4 (2.1)	1.8 (0.1)	<0.01	1.9 (0.1)
Hyperlipidemia	25.7 (2.8)	4.6 (0.1)	<0.01	4.6 (0.1)
COPD	4.3 (1.3)	1.8 (0.1)	<0.01	1.9 (0.1)



**Figure 2.** The proportion of specific comorbidities in stroke patients

Table 2 shows the results of crude and adjusted logistic regression. After controlling for confounders, it was found that almost all of the comorbid conditions studied were associated with stroke. The odds of the prevalence of stroke vary, from eight times higher in

individuals with hypertension to two times higher in people with diabetes compared to individuals without the condition. COPD also increases the odds of stroke by 1.62 times, but did not show statistical significance in this study.

## Discussion

This Indonesian population-based cross-sectional study demonstrates that: (1) hypertension is the most common comorbidity of stroke, followed by hyperlipidemia and diabetes; (2) the presence of comorbid hypertension, diabetes, heart disease, or hyperlipidemia increases the risk of stroke, but COPD is not significantly associated with an increased risk of stroke; (3) the frequency of comorbidities increases

with age, and there is a twofold increase in the age of 50 years and over compared to the previous age group. These findings emphasize the importance of controlling hypertension, diabetes, heart disease, and hyperlipidemia for the prevention of stroke and recurrent stroke, as well as improving the quality of life and life expectancy of stroke.

**Table 2.** Crude and adjusted logistic regression analysis for stroke-related comorbid conditions

Variables	Odds ratio (95% CI), <i>p</i> -value	
	Crude	Adjusted
Age (≥60 years)	7.65 (5.96 – 9.82), <0.01	3.19 (2.13 – 4.77), <0.01
Gender (male)	0.97 (0.86 – 1.69), 0.61	0.80 (0.62 – 1.04), 0.10
Education		
Less than primary education		
Elementary school	1.00 (0.13 – 7.47), 0.99	0.99 (0.11 – 9.04), 0.99
Junior high school	0.69 (0.09 – 5.25), 0.72	1.24 (0.13 – 11.67), 0.85
Senior high school	0.44 (0.06 – 3.38), 0.43	0.64 (0.07 – 6.05), 0.70
College	0.70 (0.09 – 5.34), 0.73	0.77 (0.08 – 7.32), 0.82
Insurance ownership	0.86 (0.76 – 0.98), 0.02	0.84 (0.71 – 0.99), 0.05
Nutritional status		
Normoweight		
Underweight	1.61 (0.99 – 2.62), 0.05	1.63 (0.88 – 3.01), 0.12
Overweight	1.56 (1.02 – 2.38), 0.04	1.19 (0.71 – 1.99), 0.50
Obese	2.85 (2.07 – 3.93), <0.01	1.21 (0.78 – 1.90), 0.39
Smoking	1.19 (0.93 – 1.53), 0.16	0.86 (0.49 – 1.49), 0.59
Physical activity		
Inactive		
Moderate	1.03 (0.29 – 3.68), 0.96	0.81 (0.21 – 3.10), 0.76
Active	1.48 (0.45 – 4.81), 0.52	0.94 (0.27 – 3.27), 0.92
Chronic comorbidity		
Hypertension	15.62 (11.89 – 20.52), <0.01	7.97 (5.19 – 12.26), <0.01
Diabetes	6.13 (4.29 – 8.74), <0.01	1.90 (1.14 – 3.15), 0.01
Heart disease	7.58 (5.11 – 11.25), <0.01	2.67 (1.47 – 4.85), <0.01
COPD	2.36 (1.24 – 4.46), <0.01	1.62 (0.64 – 4.07), 0.31
Hyperlipidemia	7.24 (5.41 – 9.68), <0.01	3.68 (2.40 – 5.64), <0.01

Hypertension has been widely recognized as a risk factor for stroke as well as a comorbidity. In this study, 71.6% of stroke respondents had hypertension. This is in line with another study of multinational data from 92 countries analyzed in 2022, which showed that 77% of stroke patients had hypertension.<sup>6</sup> Hypertension is the most common independent co-morbidity in long-term medical conditions and the main cause of high treatment costs due to long hospitalizations.<sup>7</sup>

According to this study, hyperlipidemia is the second most typical comorbidity for stroke. This is in accordance with a community-based cohort study in China that shows that hyperlipidemia is the second most common comorbidity after hypertension in stroke patients.<sup>8</sup> Studies have shown a consistent positive association between hyperlipidemia and stroke. Atherosclerosis is a key mechanism of hyperlipidemia that underlies its function as a risk factor for

cardiovascular disease. Endothelial dysfunction brought on by oxidative stress brought on by hyperlipidemia, diabetes, or hypertension is a symptom of the early phases, which are then followed by vascular low-density lipoprotein (LDL) oxidation.<sup>8-10</sup>

Diabetes is associated with an increased risk of stroke, in line with a population-based cohort study in Sweden that demonstrated an association of diabetes with ischemic stroke (hazard ratio (HR): 1.76, 95% CI: 1.16-2.67) and post-stroke dementia (HR: 2.56, 95% CI: 1.04-6.25) through the mechanisms of decreased arterial elasticity, impaired microvascular function, increased blood viscosity, accelerated inflammation, and reduced cognitive function recovery after stroke.<sup>11-13</sup> Diabetes is also a predictor of poor prognosis in stroke patients.<sup>3</sup>

In this investigation, there was no evidence that COPD had a substantial impact on the frequency of stroke. This is consistent with other research regarding the still debatable link between COPD and stroke. Numerous investigations have revealed a strong connection between COPD and stroke.<sup>8,14</sup> However, a systematic review covering 30 studies stated that although the prevalence and incidence of stroke are increasing in patients with COPD, the available evidence does not support the hypothesis that COPD is an independent risk factor for stroke.<sup>15</sup>

Comorbid conditions in stroke patients affect the prognosis. In a Danish study, the Charlson Comorbidity Index (CCI) was used to compare the effect sizes of 16 comorbidities on mortality risk at 30 days and 5 years. The mortality risk was shown to be 15% greater in diabetes with end-organ damage, 25% higher in COPD, and 35% higher in congestive heart failure and atrial flutter. Meanwhile, the presence of myocardial infarction and diabetes without end-organ damage did not have a significant relationship.<sup>16</sup>

Comorbidity is positively related to age, with a threefold increase in frequency in 40–49 years compared to the previous age group. After becoming 50 or older, the frequency doubled and subsequently started to decline (Figure 1). This is different from several studies in industrialized nations that reveals a rise in the frequency of comorbidities, which is still significant until the age of 70 and beyond.<sup>14,16,17</sup> One explanation is the difference in life expectancy in Indonesia, which is 69.53, lower than several developed countries such as Canada (81.80), Denmark (80.70), and the Netherlands (81.71).<sup>18,19</sup> With a lower life expectancy, the frequency of stroke aged 70 years and over who have comorbidities will also tend to be lower than in countries with a higher life expectancy. Comorbid conditions in stroke require special attention for several reasons. The additive effect of comorbidities on disease burden can contribute to

poorer health status, increased risk of mortality, decreased body function, and increased use of health services through various mechanisms, such as increasing the burden of therapy and the workload of health workers.<sup>20</sup> Comorbid conditions might make it difficult for patients to comply with post-stroke therapy requirements, for instance by limiting their ability to engage in rehabilitative therapy. Due to its effects on a person's physical, cognitive, and psychological health, a stroke might limit their capacity to maintain their health. For example, a patient's options for physiotherapy may be restricted if they have a heart condition with reduced functional capacity. Additionally, polypharmacy is linked to comorbid conditions in stroke and can exacerbate drug interactions.<sup>2</sup>

Comorbidity management is expected to reduce stroke recurrence, morbidity, and mortality. Screening and management of hypertension play an important role in reducing the incidence and recurrence of stroke.<sup>6</sup> Reducing LDL cholesterol levels with lipid-lowering drugs, such as statins, is important for reducing mortality and morbidity in stroke patients.<sup>9</sup> Diabetes management plays a role in preventing recurrent strokes.<sup>21</sup> It is clear that an understanding of the prevalence of co-morbidities in stroke and their relationship to health outcomes is necessary for better evaluation and planning of stroke services.

The strength of this study is the use of a national population-based survey, which represents more than 80% of Indonesia's population, enabling robust statistical analysis. This study has limitations in the nature of the cross-sectional design used, so it can only assess associations and not causality. Self-reporting may also result in incorrect disease classification and recall bias.

## Conclusion

In conclusion, around 78% of stroke survivors in Indonesia have comorbid medical conditions. The number of comorbidities increases with age.

## Acknowledgment

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