



*Original Article*

## **Difference Between BMI at Admission and Discharge and NIHSS at Admission and Discharge in Ischemic Stroke Patients at Dr. Kariadi Hospital**

Annisa Fauziah, Hertanto Wahyu Subagio, Annta Kern Nugrohowati,  
Darmono SS, Enny Probosari

Department of Clinical Nutrition Faculty of Medicine Diponegoro University Semarang, Indonesia

### Abstract

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**Author Affiliation:**  
Department of Clinical Nutrition  
Faculty of Medicine Diponegoro University  
Semarang, Indonesia

**Author Correspondence:**  
Annisa Fauziah  
Dr. Sutomo Street No. 16 Semarang,  
Central Java 50244, Indonesia

**E-mail:**  
Annisaaji123@gmail.com

**Background :** Hospitalized patients are at risk for malnutrition. Decreased BMI (Body Mass Index) in stroke patients is negatively correlated with patient outcomes. Studies on differences in BMI and NIHSS (National Institutes of Health Stroke Scale) at admission and discharge in stroke patients have not been conducted in Indonesia. This study was aimed to describe the difference between BMI and NIHSS at admission and discharge in ischemic stroke patients at Dr. Kariadi hospital

**Methods :** An observational study on 49 hospitalized ischemic stroke patients at the Stroke Unit of dr. Kariadi hospital. Outcomes were measured using the National Institutes of Stroke Scale (NIHSS). Data was collected from the patient's medical record and analyzed using Paired Sample t Test.

**Results :** There was no significant difference between BMI at admission and discharge ( $p = 0.161$ ). There was a significant difference between the NIHSS at the time of admission and at the time of discharge ( $p = 0.014$ ).

**Conclusion :** There is no significant difference between BMI at admission and discharge. There is functional improvement in ischemic stroke patients during treatment.

**Keywords :** Stroke BMI, Stroke Outcome, NIHSS

## INTRODUCTION

Patients undergoing treatment in hospitals are at risk of experiencing malnutrition. The prevalence of malnutrition in hospitalized patients ranges widely from 20% to 50%. If left untreated, this can reduce the patient's nutritional status during treatment. Of patients who were not malnourished at the time of admission, one third will experience a decrease in nutritional status during the hospitalization period.<sup>1</sup> Stroke patients undergoing treatment in hospital may experience malnutrition as illustrated by a decrease in body mass index (BMI). Some things that can be a risk factor for malnutrition in stroke patients include BMI at the time of admission to hospital, polypharmacy, eating difficulties, chronic diseases, functional disabilities, and high scores on the *National Institutes of Health Stroke Scale* (NIHSS).<sup>2</sup> In addition, decreased BMI in stroke patients can also be due to high catabolic processes due to inflammatory processes and oxidative stress conditions, as well as inadequate energy and protein intake, which is exacerbated by failure of anabolic stimulation, especially in the acute phase after stroke.<sup>3</sup> The NIHSS is a systematic assessment tool that quantitatively measures stroke-associated neurologic deficits. The NIHSS is a quantitative neurological assessment that includes evaluation of level of consciousness, visual field, facial expression, motor power, ataxia, language, dysarthria, and consciousness. NIHSS can be used to measure the severity and outcome of stroke patients. The NIHSS has a score ranging from 0 to 42. Higher scores are associated with increased stroke severity and a poorer prognosis.<sup>13,14</sup>

Malnutrition and dysphagia that occur in the acute post stroke period are associated with poor outcomes. Identification and nutrition therapy for malnutrition conditions need to be done immediately so that optimal improvement of body function can be achieved.<sup>5,6</sup> Proper nutrition has been shown to significantly improve the physical and mental function of stroke patients by maintaining muscle and fat mass, shortening the hospitalization period, and improving functional outcomes.<sup>7</sup> There is no study that compares BMI and NIHSS at admission and NIHSS at discharge in ischemic stroke patients in Indonesia. Therefore, research is needed to analyze whether there is a significant difference between BMI and NIHSS at admission and at discharge to describe the effect of proper nutrition to prevent malnutrition and improve ischemic stroke patient outcomes.

## METHODS

This study uses an observational design. The data is in the form of secondary data obtained from the medical records of patients from the Stroke Unit of Dr. Kariadi Hospital for six months, from October 2021 to March

2022. Initial and final BMI data, NIHSS, length of stay, age, and gender were taken from the patient's medical records. The required number of samples is calculated using the formula:

$$n = \left[ \frac{(Z\alpha + Z\beta)}{0.5 \ln \{(1+r)/(1-r)\}} \right]^2 + 3$$

Type I error is set at 5%, type II error is set at 20%. The minimum correlation that is considered significant (r) is set at 0.506. By using this formula, the minimum sample size required is 28. The research subjects were selected by *non-random sampling*, namely using the *consecutive sampling* of ischemic stroke patients treated at the Stroke Unit of RSUP Kariadi Semarang. The inclusion criteria were ischemic stroke patients who were hospitalized at the Stroke Unit of RSUP Dr. Kariadi, age >18 years, and complete medical record data. Exclusion criteria were patients with edema or ascites. In this study, the number of samples obtained was 49 subjects.

The variables studied were BMI at admission and at discharge and NIHSS at admission and at discharge. BMI is obtained by calculating the value of body weight at admission divided by height in the square.

Body weight is calculated using a formula based on upper arm circumference, namely:

- For male:  
Body Weight =  
Arm Circumference : 26.3 x (Height - 100)
- For female:  
Body Weight =  
Arm Circumference : 25.7 x (Height - 100)

Body height is calculated using a formula based on knee height:

- For male:  
Body Height = (2.02x Knee Height) - (0.04xAge) + 64.19
- For females:  
Body Height = (1.83xKnee Height) - (0.24xAge) + 84.88

Data was processed using a computer, with descriptive tests on nominal scale data displayed in the form of amounts (n) and percentages, data with a numerical scale are shown in the form of *mean* and standard deviation. A paired sample t test is used to determine significant difference between groups. The results of paired sample t tests are said to be significant if they meet the p value <0.05. This research has obtained *ethical clearance* from the Medical Research Ethics Commission at Diponegoro University and Dr. Kariadi General Hospital, Semarang.

## RESULTS

The study was conducted on 49 Ischemic Stroke patients who were hospitalized at the Stroke Unit of RSUP Dr.

TABLE 1  
**Basic Characteristics of Research Subjects**

Variable		F	%	Unit
Gender	Man	35	71.4	People
	Age ≥60 years	22	44.9	People
	Age <60 years	13	26.5	People
	Woman	14	28.6	People
	Age ≥60 years	12	24.5	People
	Age <60 years	2	4.1	People
Food Intake	< 60% of target	2	4.1	kcal
	60–99% of target	24	49.0	kcal
	100 % of target	23	46.9	kcal

TABLE 2  
**Data Description**

Variable	Mean ± SD	Median (Min–Max)
Age (years)	61.2 ± 9.37	62 (26–86)
Length of treatment (days)	15.2 ± 11.26	12 (3–63)
BMI at admission (kg/m <sup>2</sup> )	24.6 ± 4.18	25.15 (17.33–35.94)
BMI at discharge (kg/m <sup>2</sup> )	24.4 ± 4.23	24.78 (17.33–35.94)
BMI difference (kg/m <sup>2</sup> )	-0.2 ± 0.84	0.00 (-4.01–1.47)
NIHSS at admission	9.0 ± 4.09	8 (1–17)
NIHSS at discharge	8.3 ± 3.90	7 (1–16)
NIHSS difference	0.7 ± 1.84	0.0 (-2.0–9.0)

TABLE 3  
**Difference test between initial BMI and final BMI**

Paired Samples Test	Mean	Std. Deviation	Paired Differences			t	df	Sig. (2-tailed)
			Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1								
Initial BMI – final BMI	.17121	.84266	.12038	-.07083	.41326	1.422	48	.161
Pair 2								
NIHSS at admission – NIHSS at discharge	.673	1.842	.263	.145	1.202	2.560	48	.014

Kariadi Semarang. The characteristics of the research subjects are described in Table 1. Most of the research subjects were male, namely 71.4%, while 28.6% were female. The majority of research subjects are aged  $\geq 60$  years, namely 33 patients (67.3%). The youngest is 26 years old and the oldest is 86 years. The majority of research subjects received food intake  $\geq 60\%$  of target. Twenty-four research subjects received food intake  $\geq 60\%$  of target and 23 research subjects had achieved 100% food intake as targetted. Only two research subjects had not reached 60% of target.

A description of the research data can be seen in Table 2. The minimum length of stay is 3 days, the maximum is 63 days, and the average is 15.2 days. Both BMI at admission and discharge have a minimum value of 17.33 kg/m<sup>2</sup> and a maximum of 35.94 kg/m. The difference in BMI during treatment averaged -0.2 kg/m<sup>2</sup> with an SD of 0.84. Test results of Paired Sample t Test showed no significant difference between BMI at admission and BMI at discharge ( $t=1.422$ ,  $p=0.161$ ). NIHSS at admission averaged 9.0 and NIHSS at discharge averaged 8.3. Test results Paired Sample t Test showed a significant difference between NIHSS at admission and NIHSS at discharge ( $t=2.560$ ,  $p=0.014$ ).

## DISCUSSION

Stroke is a functional disorder of the brain that occurs suddenly due to impaired blood circulation in the brain.<sup>8</sup> Stroke is one of the leading causes of morbidity and mortality in various countries.<sup>9,10</sup> The Indonesian Ministry of Health in 2013 stated that stroke is the number one cause of death and disability in Indonesia. The prevalence of stroke in Indonesia is 7 per 1000 population.<sup>11</sup> Stroke patients who are hospitalized can experience malnutrition as illustrated by the decrease in body mass index (BMI). Research by Dewi found that more stroke patients are malnourished than those who are not.<sup>12</sup> The causes of malnutrition in stroke patients include paralysis and neurological deficits.<sup>13</sup> The decrease in BMI in stroke patients can also be caused by a high level of catabolism. The high catabolism in stroke patients is caused by inflammatory processes and oxidative stress conditions, inadequate energy and protein intake, and exacerbated by anabolic failure, especially in the acute phase after stroke.<sup>14</sup> Subarachnoid hemorrhage (SAH) causes an increase resting energy expenditure (REE) which is higher than ischemic stroke and intracerebral hemorrhage (ICH).<sup>2</sup> Outcomes of stroke patients can be measured using National Institutes of Health Stroke Scale (NIHSS).<sup>15</sup>

Several things that can be risk factors for malnutrition in stroke patients include BMI at hospital admission, polypharmacy, eating difficulties, comorbid diseases, functional disabilities, and high score of National Institutes of Health Stroke Scale (NIHSS) which

is high.<sup>2</sup> Neurological deficits such as decreased visual function, weakness of the upper limbs, and decreased intake can trigger depression and apraxia which affect patient's ability to eat, thereby increasing the risk of malnutrition.<sup>6</sup> Weight loss after stroke can be caused by a negative energy balance caused by a deficit in caloric intake and the inflammatory condition experienced by the patient, which in turn can lead to an increase in sarcopenia that occurs due to paresis and a decrease in physical activity. Catabolic-anabolic imbalance can be further exacerbated by increased catabolic drive and failure of anabolic stimulation.<sup>15</sup> Weight loss in stroke patients has a negative correlation with patient outcomes and the return of physical function in the long term, so it is important to prevent this decrease in muscle mass.<sup>16,17</sup> Approximately 40% of stroke patients in rehabilitation centers, especially stroke patients with dysphagia are at risk for suffering from malnutrition during the treatment process.<sup>18</sup> Malnutrition in stroke patients has a negative impact on patient outcomes. This is because at the cellular level, the protein and energy deficiencies that occur when a patient is admitted to the hospital can interfere with the recovery of hippocampal fibers in ischemic brain injury by changing the expression of *trkB* and the *GAP-43* protein.<sup>2</sup> Stroke patients with malnutrition have a higher mortality rate (37%) than stroke patients with normal nutritional status (21%).<sup>19</sup>

It is known that in the acute phase of stroke, oxidative stress occurs which suppresses protein synthesis resulting in disruption in brain recovery. Proper nutrition since that phase has been proven to significantly improve the physical and mental function of stroke patients by maintaining muscle and fat mass, shortening the hospitalization period, and improving functional outcomes.<sup>7</sup>

This study assessed differences in BMI at admission and BMI at discharge as well as NIHSS at admission and NIHSS at discharge in stroke patients who were hospitalized at the Stroke Unit of RSUP Dr. Kariadi Semarang. All ischemic stroke patients who are hospitalized in the Stroke Unit of Dr. Kariadi received integrated treatment between medical therapy and medical nutrition therapy by a clinical nutrition specialist immediately from the time the patient was admitted, thus allowing to decrease the level of inflammation and the risk of catabolism. This is reflected in the distribution of research data which shows that the majority of research subjects (95.9%) received intake  $\geq 60\%$  of the target with 23 research subjects (46.9%) having achieved intake of 100% of the target. This study showed that there was no significant difference between BMI at admission and discharge ( $t=1.422$ ,  $p=0.161$ ). The result of Paired Sample t Test showed a significant difference between NIHSS at admission and NIHSS at discharge ( $t=2.560$ ,  $p=0.014$ ). NIHSS at discharge showed improvement compared to NIHSS at admission which illustrates an improvement in

the outcome of ischemic stroke patients undergoing hospitalization at the Stroke Unit of RSUP Dr. Kariadi Semarang. The significant improvement of NIHSS accompanied by no significant decrease in BMI in ischemic stroke patients who were hospitalized at the Stroke Unit of Dr. Kariadi Hospital Semarang demonstrated the role of medical nutrition therapy along with integrated medical therapy so as to minimize weight loss in acute phase ischemic stroke patients and improve patient outcomes. This is in line with the study of Aquilani *et al.* which said that providing proper nutrition since the acute phase of stroke is proven to significantly improve the physical and mental function of stroke patients by maintaining muscle and fat mass, shortening the hospitalization period, and improving functional outcomes.<sup>7</sup> This is also in line with the research of Nii M *et al.* who said that nutritional therapy while in hospital is related to functional improvement in stroke patients.<sup>20</sup>

### CONCLUSION

There was no significant difference between BMI at admission and BMI at discharge which indicated that the patient's weight during treatment tended to be stable. There was a significant difference between the NIHSS at admission and at discharge which showed an improvement in outcomes during hospitalization. This shows the role of medical nutrition therapy together with integrated medical therapy in minimizing weight loss and improving patient outcomes in acute phase ischemic stroke patients who were hospitalized at the Stroke Unit of Dr. Kariadi Hospital Semarang.

The limitation of this study is the exclusion of various factors that influence the outcome of ischemic stroke patients, namely age, function and physical disability pre-stroke, severity of initial symptoms, education, diabetes mellitus, and baseline CT scan. Further research is necessary using more specific nutritional status assessment parameters such as body composition examination in order to obtain more detailed data.

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