

## Original Research Article

# Correlation of blood glucose levels, HbA1c, hemoglobin and leukocytes with outcome on acute stroke

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## ABSTRACT

**Background:** Diabetes and higher HbA1c level have increased the incidence of stroke. Hemoglobin levels both high and low are associated with poor outcomes. Leukocytes play an important role in the initiation of the atherosclerosis process.

**Methods:** This was a cross-sectional study with a sample size of 62 people selected by non-random sampling method on a consecutive basis, patients with acute stroke were taken blood to measure blood glucose levels, HbA1c, Hb and Leukocytes when entering the hospital room. Outcomes were assessed using NIHSS and MRS. The calculation of NIHSS and MRS scores was performed on the first day of admission and the fourteenth day. To analyze the correlation of blood sugar levels during HbA1c, Hb and leukocytes in acute stroke, this study used Spearman's correlation test. The p value <0.05 was considered statistically significant.

**Results:** The study subjects of 62 acute stroke patients (acute ischemic stroke 31 people and 31 people hemorrhagic stroke). Acute stroke patients were consisted of 38 men (61.3%) and 24 women (38.7%). Of 31 people with hemorrhagic stroke, there were 16 men (51.6%) and 15 women (48.4%), ischemic stroke patients were consisted of 22 people (71, 0%) and women were 9 people. Spearman repair test showed no symptoms between blood glucose levels, HbA1c, Hemoglobin and leukocytes with outcomes in acute stroke.

**Conclusions:** There was no significant association between blood glucose levels, HbA1c, hemoglobin and leukocytes with outcomes in acute stroke.

**Keywords:** Blood glucose adrandom, Hb, HbA1c, Leukocyte, Stroke

## INTRODUCTION

Stroke is leading cause of disability and mortality among the elderly population and 75% of all cases are ischemic strokes while 15% are hemorrhagic strokes.<sup>1</sup>

The Hjalmarsson et al study discovers that prestroke glycemic control disorder or baseline HbA1c is an independent risk factor for poor survival and an unwelcome functional outcome after suffering from an ischemic stroke.<sup>2</sup>

Low hemoglobin or anemia is a condition that is common in older adults, the prevalence increases with age. Anemia is associated with increased mortality, disability and poor physical performance regardless of underlying causes of low hemoglobin levels. High and low hemoglobin levels are associated with poor outcomes in acute ischemic stroke.<sup>2</sup>

Leukocytes play an important role in the initiation and propagation of the atherosclerosis process and the number of leukocytes has been shown to be associated

with an increased risk of stroke. A study showed that leukocytes count was the prediction of the first ischemic stroke after adjusting for vascular risk factors. However, there is no consensus about the relationship between leukocyte count and the prognosis of cerebral infarction after onset. Several studies have found that an increase in number of leukocytes on the first day of acute ischemic stroke is a prognosis factor in disease progression and the number of leukocytes is an important predictive factor of death in the hospital. There are also several studies that have found no association between leukocytes count at the time of entry with clinical outcomes. In China there are no large numbers of sample data on the relationship between leukocytes count down entering and short term in clinical outcomes in patients with acute cerebral infarction.<sup>3,4</sup>

This study aims to examine the correlation between the time of blood sugar levels, HbA1c, hemoglobin and leukocytes with outcomes in ischemic stroke and acute hemorrhagic stroke.

## METHODS

This research is descriptive analytic with cross-sectional data collection method with acute ischemic stroke patients and acute hemorrhagic stroke and carried out August 2017 to October 2017. A total of 62 patients each of 31 acute ischemic stroke patients and 31 acute hemorrhagic stroke patients who enter the neurology inpatient room RSUP H. Adam Malik Medan has been enforced with anamneses, physical examination, neurological examination and head CT scan and that meets the inclusion criteria. Patients with recurrent stroke, chronic kidney failure and blood malignancy were excluded from this study. All patients included in the inclusion criteria were taken for venous blood to be sent to the Clinical Pathology laboratory in Medan, Adam Malik Hospital, as many as 3 cc immediately after the patients came to H. Adam Malik General Hospital in Medan to check for blood sugar levels, Hemoglobin and leukocytes. After in the inpatient room an HbA1c examination is carried out by a laboratory analyst. At the time of initial admission of NIHSS D-1 and D-1 mRS were assessed day to 14 strokes with NIHSS D-14 and D-14 Mrs.

The research data will be analyzed statistically using the help of the Windows Statistical Product and Science Service (SPSS) computer program. Descriptive analysis was used to see the description of the patient's demographic characteristics and to see the correlation of the blood sugar levels, HbA1c, hemoglobin and leukocytes in acute ischemic stroke and acute hemorrhagic stroke, using the Spearman correlation test.

## RESULTS

Of the 62 acute stroke patients analyzed, there were 38 men (61.3%), and 24 women (38.7%). Of the 31 people

with ischemic stroke, men were found consisting of 22 people (71.0%) and women as many as 9 people (29.0%) while those of 31 people with hemorrhagic stroke found that men consisted of 16 people (51.6%) and women as many as 15 people (48.4%). The average age of 31 people with ischemic stroke was  $52.71 \pm 10.89$  years, while those with hemorrhagic stroke were  $52.19 \pm 14.12$  years. Table of demographic characteristics of research subject can be seen in Table 1.

**Table 1: Demographic characteristics of research subjects.**

Demographic characteristics	n = 62	
	SI	SH
<b>Sex, n (%)</b>		
Male	22 (71.0)	16 (51.6)
Female	9 (29.0)	15 (48.4)
Average age (SD), yrs.	52.71(10.89)	52.19(14.12)
<b>Job, n (%)</b>		
Farmer	6 (19.4)	9 (29.0)
Housewife	4 (12.9)	7 (22.6)
Government employees	9 (29.0)	6 (19.4)
Enterpriser	12 (38.7)	4 (12.9)
Do not have a job	0	3 (9.7)
Pensionary	0	2 (6.5)
<b>Education, n (%)</b>		
Primary school	4 (12.9)	6 (19.4)
Junior high school	2 (6.5)	5 (16.1)
Senior high school	22 (71.0)	17 (54.8)
Bachelor degree	3 (9.7)	3 (9.7)
<b>Ethnic, n (%)</b>		
Batak	12 (38.7)	14 (45.2)
Karo	7 (22.6)	6 (19.4)
Jawa	5 (16.1)	5 (16.1)
Mandailing	2(6.5)	3 (9.7)
Aceh	4 (12.9)	2 (6.5)
Melayu	0	1 (3.2)
Nias	1 (3.2)	0

Based on statistical analysis using the Spearman correlation test There was no significant correlation in acute MCC stroke between KGDS and NIHSS D-1 and there was a significant correlation between KGDS and NIHSS D-14 ( $p = 0.01$ ;  $r = 0.93$ ). There was no significant correlation between KGDS and D-1 mRS ( $p = 0.87$   $r = 0.03$ ) with D-14 mRS ( $p = 0.98$   $r = 0.00$ ). There was no significant correlation between stroke between HbA1c and NIHSS D-1 ( $p = 0.31$ ;  $r = 0.18$ ), NIHSS D-14 ( $P = 0.84$ ;  $r = 0.03$ ). With D-1 mRS ( $P = 0.76$ ;  $r = 0.06$ ) D-14 mRS ( $p = 0.96$ ;  $r = 0.01$ ). There was no significant correlation in acute ischemic stroke between Hb and NIHSS D-1 ( $p = 0.24$ ;  $r = 0.22$ ), NIHSS D-14 ( $p = 0.65$ ;  $r = 0.08$ ). With MRS D-1 ( $p = 0.59$ ,  $r = 0.09$ ), mRS H-14 ( $p = 0.75$ ;  $r = 0.06$ ). There was no significant correlation in acute ischemic stroke between leukocytes and NIHSS

D-1 ( $p = 0.30$ ;  $r = 0.19$ ), NIHSS D-14 ( $p = 0.68$ ;  $r = 0.08$ ). With D-1 mRS ( $p = 0.31$ ;  $r = 0.19$ ), D-14 mRS ( $p = 0.87$ ;  $r = 0.03$ ) (Table 2).

**Table 2: Correlation blood glucose level, HbA1c, hemoglobin, and leukocytes with outcomes in ischemic stroke patients (n = 31).**

Correlation between variables		n	r	p
Blood glucose level with	NIHSS D-1	31	0.32	0.86*
	NIHSS D-14	31	0.93	0.01*
	mRS D-1	31	0.03	0.87*
	mRS D-14	31	0.00	0.98*
HbA1c with	NIHSS D-1	31	0.18	0.31*
	NIHSS D-14	31	0.03	0.84*
	mRS D-1	31	0.06	0.76*
	mRS D-14	31	0.01	0.96*
Hb with	NIHSS D-1	31	0.22	0.24*
	NIHSS D-14	31	0.08	0.65*
	mRS D-1	31	0.09	0.59*
	mRS D-14	31	0.06	0.75*
Leukocytes with	NIHSS D-1	31	0.19	0.30*
	NIHSS D-14	31	0.08	0.68*
	mRS D-1	31	0.19	0.31*
	mRS D-14	31	0.03	0.87*

**Table 3: Correlation blood glucose level, HbA1c, hemoglobin, and leukocytes with outcomes in hemorrhagic stroke patients (n = 31).**

Correlation between variables		n	r	p
Blood glucose level with	NIHSS D-1	31	0.05	0.05*
	NIHSS D-14	31	0.02	0.02*
	mRS D-1	31	0.16	0.16*
	mRS D-14	31	0.14	0.14*
HbA1c with	NIHSS D-1	31	-0.22	-0.22*
	NIHSS D-14	31	-0.27	-0.27*
	mRS D-1	31	-0.14	-0.14*
	mRS D-14	31	-0.17	-0.17*
Hb with	NIHSS D-1	31	-0.23	-0.23*
	NIHSS D-14	31	-0.28	-0.28*
	mRS D-1	31	-0.23	-0.23*
	mRS D-14	31	-0.20	-0.20*
Leukocytes with	NIHSS D-1	31	0.31	0.31*
	NIHSS D-14	31	0.34	0.34*
	mRS D-1	31	0.31	0.31*
	mRS D-14	31	0.31	0.31*

There was no significant correlation in acute hemorrhagic stroke between KGDS with NIHSS D-1 ( $p = 0.79$ ;  $r = 0.05$ ) and NIHSS D-14 ( $p = 0.89$ ;  $r = 0.02$ ), with mRS D-1 ( $p = 0.38$ ;  $r = 0.16$ ) and mRS D-14 ( $p = 0.43$ ;  $r = 0.14$ ). There was no significant correlation in acute hemorrhagic stroke between HbA1c with NIHSS D-1 ( $p = 0.23$ ;  $r = -0.22$ ) and NIHSS D-14 ( $p = 0.14$ ;  $r = -0.27$ ), mRS D-1 ( $p = 0.47$ ;  $r = 0.37$ ) and D-14 mRS ( $p = 0.37$ ;  $r = -0.17$ ).

There was no significant correlation in acute hemorrhagic stroke between Hb with NIHSS D-1 ( $p = 0.22$ ;  $r = -0.23$ ) and NIHSS D-14 ( $p = 0.13$ ;  $r = -0.28$ ), mRS D-1 ( $p = 0.22$ ;  $r = -0.23$ ) and D-14 mRS ( $p = 0.28$ ;  $r = -0.20$ ). There is no significant correlation in acute hemorrhagic stroke between leukocytes with NIHSS D-1 ( $p = 0.09$ ;  $r = 0.31$ ) and NIHSS D-14 ( $p = 0.06$ ;  $r = 0.34$ ), D-1 mRS ( $p = 0.09$ ;  $r = 0.31$ ) and mRS D-14 ( $p = 0.09$ ;  $r = 0.31$ ) (Table 3).

**DISCUSSION**

This study is a descriptive analytic study with cross-sectional data collection method which aims to determine the correlation of blood sugar levels, HbA1c, hemoglobin and leukocytes with outcomes in patients with ischemic stroke and acute hemorrhagic stroke.

In this study, all acute stroke patients, both ischemic and hemorrhagic who had been diagnosed with head CT scan, were consecutively taken who fulfilled the inclusion criteria and there were no exclusion criteria, checked for blood sugar levels, HbA1c, hemoglobin and leukocytes.

From the demographic data, the overall acute stroke patients with both ischemic stroke and acute hemorrhagic stroke with male sex more than women in the percentage of 61.3%, this is in accordance with the study of Nomani et al. from 233 stroke patients obtained 133 (57, 0%) men and 100 (42.9%) women. In accordance with the Karunawan et al, it was found that 102 ischemic stroke patients were assigned 65 male patients (63.7%) and 37 female patients (36.3%) whereas according to Rambe et al from 562 people with acute stroke, men were found males were 266 people (47.3%) and women 296 people (52.7%). According to the 2013 Santalucia et al. Study it was said that female sex had more strokes. In particular, women were reported to have more aphasia, dysphagia and visual field disorders than men, while no differences were reported for motor and sensory deficits.<sup>5-8</sup>

From the demographic data obtained hemorrhagic stroke patients with an average age of 52.19±14.12 years whereas in ischemic stroke patients the mean age was 52.71±10.88 years, according to Bushnell et al that stroke patients female sex live longer, and risk Lifelong strokes at the age of 55-75 years are higher in women than men.<sup>9</sup>

From the demographic data in this study obtained ischemic stroke patients and acute hemorrhagic stroke with a level of education that is more high school, where in the study of Samal et al, which states the role of education is needed to reduce the occurrence of risk factors for stroke by 40%.<sup>10</sup>

Based on the results of the Spearman correlation test, the p value between KGDS and NIHSS D-1 in acute ischemic stroke patients was 0.86 with a r value of 0.32. While the NIHSS D-14 obtained a p value of 0.01, with a r value of 0.93 so it can be concluded that there is no

significant correlation between KGDS with NIHSS D-1 and NIHSS D-14 in ischemic stroke. In the D-1 mRS p value is 0.87, with a r value of 0.03. In the D-14 mRS p value is 0.98 with a r value of 0.00. So, it can be concluded that there is no significant correlation between KGDS and D-1 mRS and D-14 mRS in ischemic stroke patients. Similarly, in patients with acute hemorrhagic stroke, the p value between KGDS and NIHSS D-1 is 0.79 with a r value of 0.05. Whereas the NIHSS D-14 obtained a p value of 0.89, with a r value of 0.02 so it can be concluded that there was no significant correlation between KGDS with NIHSS D-1 and NIHSS D-14 in hemorrhagic stroke. In the D-1 mRS p value is 0.38, with a r value of 0.16. In the D-14 mRS p value is 0.43 with a r value of 0.14. So, it can be concluded that there is no significant correlation between KGDS and D-1 mRS and D-14 mRS in hemorrhagic stroke patients.

This is in accordance with Munir study that there was no relationship between blood glucose levels at the time of admission to the emergency room and the results of clinical outcomes of acute ischemic stroke patients. However, normal blood glucose levels show better improvement and tend to have better outcome outcomes. The results obtained when blood glucose levels in acute phase stroke patients are not statistically significant can be due to other factors that affect outcomes such as high blood pressure, history of hypertension, history of dyslipidemia, overweight, alcohol consumption and smoking history, where these factors were not considered in this study.<sup>11</sup>

Based on the results of the Spearman correlation test, the p value between HbA1c and NIHSS D-1 in acute ischemic stroke patients was 0.31 with a r value of 0.18. While the NIHSS D-14 obtained a p value of 0.84, with a r value of 0.03 so it can be concluded that there is no significant correlation between HbA1c with NIHSS D-1 and NIHSS D-14 in ischemic stroke. In the D-1 mRS p value is 0.76, with a r value of 0.06. In the D-14 mRS p value is 0.96 with a r value of 0.01. So, it can be concluded that there is no significant correlation between HbA1c and D-1 mRS and D-14 mRS in ischemic stroke patients. Likewise, in hemorrhagic stroke patients, the p value between HbA1c and NIHSS D-1 is 0.23 with a r value of -0.22. Whereas the NIHSS D-14 obtained a p value of 0.14, with a r value of -0.27 so it can be concluded that there was no significant correlation between HbA1c and NIHSS D-1 and NIHSS D-14 in hemorrhagic stroke. In the D-1 mRS p value is 0.47, with a r value of -0.14. In the D-14 mRS p value is 0.37 with a r value of -0.17. So, it can be concluded that there is no significant correlation between HbA1c and D-1 mRS and D-14 mRS in hemorrhagic stroke patients.

Based on the results of the Spearman correlation test, the p value between Hb and NIHSS D-1 in acute ischemic stroke patients was 0.24 with a r value of 0.22. While the NIHSS D-14 obtained a p value of 0.65 with a r value of 0.08 so it can be concluded that there is no significant

correlation between Hb and NIHSS D-1 and NIHSS D-14 in ischemic stroke. In the D-1 mRS p value is 0.59, with a r value of 0.09. In the D-14 mRS p value is 0.75 with a r value of 0.06. So, it can be concluded that there is no significant correlation between Hb and D-1 mRS and D-14 mRS in ischemic stroke patients. Likewise, in hemorrhagic stroke the p value between Hb and NIHSS D-1 is 0.22 with a r value of -0.23. Whereas the NIHSS D-14 obtained a p value of 0.13 with a r value of -0.28 so it can be concluded that there was no significant correlation between Hb and NIHSS D-1 and NIHSS D-14 in hemorrhagic strokes. In the D-1 mRS p value is 0.22, with a r value of -0.23. In the D-14 mRS p value is 0.28 with a r value of -0.20. So, it can be concluded that there is no significant correlation between Hb and D-1 mRS and D-14 mRS in hemorrhagic stroke patients.

According to Furlan et al, an increase in hemoglobin concentration at the start of admission was associated with more severe strokes, greater disability at discharge and more than 30 days of death after acute ischemic stroke. Low hemoglobin concentration at the time of admission was associated with hospital length of stay.<sup>9</sup> Barlas et al say strong evidence shows that patients with anemia have increased mortality with stroke. Increased hemoglobin was also associated with increased mortality, especially in the first month. The evidence base is measured in a meta-analysis. Anemia at admission was found to be associated with an increased mortality risk in both ischemic strokes (8 studies; odds ratio 1.97 [95% CI 1.57-2.47]) and hemorrhagic stroke (4 studies; odds ratio 1.46 [95% CL 1.23-1.74]). This is probably because in this study there were no very low hemoglobin levels. The lowest value of hemoglobin level in this study was 11.1mg/dl.<sup>12,13</sup>

Based on the results of the Spearman correlation test, the p value between Leukocytes and NIHSS D-1 in acute ischemic stroke patients was 0.30 with a r value of 0.19. While the NIHSS D-14 obtained a p value of 0.68, with a r value of 0.08 so it can be concluded that there is no significant correlation between leukocytes with NIHSS D-1 and NIHSS D-14 in ischemic stroke. In the D-1 mRS p value is 0.31, with a r value of 0.19. In the H-14 mRS p value is 0.87 with a r value of 0.03. So, it can be concluded that there is no significant correlation between leukocytes and D-1 mRS and D-14 mRS in ischemic stroke patients. Similarly, in hemorrhagic strokes, the p value between leukocytes and NIHSS D-1 was 0.09 with a r value of 0.31. While the NIHSS D-14 obtained a p value of 0.06, with a r value of 0.34 so it can be concluded that there was no significant correlation between leukocytes with NIHSS D-1 and NIHSS D-14 in hemorrhagic strokes. In the D-1 mRS p value is 0.09, with a r value of 0.31. In the D-14 mRS p value is 0.09 with a r value of 0.31. So, it can be concluded that there is no significant correlation between leukocytes and D-1 mRS and D-14 mRS in hemorrhagic stroke patients.

Peng et al, conducted a large sample study on the relationship between leukocyte count at admission and short-term outcome in patients with acute cerebral infarction. The increase in leukocyte count upon admission was found to be independently related to hospital death and dependency between patients with acute cerebral infarction. Recent evidence shows that atherosclerosis is an inflammatory condition. Observations indicate that the number of leukocytes at the time of entry may predict the occurrence of poor outcomes in the short term between patients with acute cerebral infarction.<sup>4</sup>

This study has limitations. First, things that can affect blood sugar levels when, HbA1c, Hemoglobin and leukocytes are not adjusted for this study. Secondly, this study only took blood samples for examination of blood sugar levels when, HbA1c, Hemoglobin and leukocytes during the course of the disease and examination of levels before the occurrence of the disease was not done so that this study could be biased. The third number of research samples is still relatively small to provide results that are responsive.

## CONCLUSION

In patients with acute ischemic stroke and acute hemorrhagic stroke blood glucose levels when HbA1c, hemoglobin and leukocytes do not have a statistical correlation with outcome.

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## REFERENCES

1. Badiger S, Akkasaligar TP, Narone U. Hyperglycemia and stroke. *Int J Stroke Res.* 2013;1(1):1-6.
2. Hjalmarsson C, Manhem K, Bokemark L, Andersson B. The role of prestroke glycemic control on severity and outcome of acute ischemic stroke. *Stroke research and treatment.* 2014;10:1-7.
3. Tanne D, Molshatzki N, Merzeliak O, Tsabari R, Toashi M, Schwammenthal Y. Anemia status, hemoglobin concentration and outcome after acute stroke: a cohort study. *BMC Neurology.* 2010 Dec;10(1):22.
4. Peng Y, Wang D, Zhang J, Xue X, Wang Z, Tong W, et al. Relationship between white blood cell count at admission and short term outcome in patients with acute cerebral infarction. *Clin Investigative Med.* 2011 Aug 1;34(4):249-54.
5. Nomani AZ, Nabi S, Ahmed S, Iqbal M, Rajput HM, Rao S. High HbA1c is associated with higher risk of ischaemic stroke in Pakistani population without diabetes. *Stroke Vascular Neurol.* 2016 Sep 1;1(3):133-9.
6. Karunawan HN, Pinzon TR, Saputro AS. Effects of Hyperglycemia Conditions on Entering Hospital Against Functional Outcomes of Stroke Patients in Hospitals Bethesda. *Mirror World Medicine.* 2016;43(2):87-90.
7. Rambe AS, Fithrie A, Nasution I, dan Tonam. Profile of Stroke Patients at 25 Hospitals in North Sumatera 2012, Hospital Based Survey. *Neuron.* 2013;30(2):1-7.
8. Santalucia P, Pezzella FR, Sessa M, Monaco S, Torgano G, Anticoli S, et al. Sex differences in clinical presentation, severity and outcome of stroke: results from a hospital-based registry. *European J Int Med.* 2013 Mar 1;24(2):167-71.
9. Bushnell C, Louise D, Awad IA, Chireau MV, Fedder WN, Furie KL, et al. Guidelines for the Prevention of Stroke in women. *Stroke.* 2014;45:001-045.
10. Samal D, Greisenegger S, Auff E, Lang W, Lalouschek W. The relation between knowledge about hypertension and education in hospitalized patients with stroke in Vienna. *Stroke.* 2007 Apr 1;38(4):1304-8.
11. Munir B, Rasyid AH, dan Rosita R. Relationship between random blood glucose levels at when entering emergency room with results clinical output of ischemic stroke phase patient. *MNJ.* 2015;1(2):53-60.
12. Furlan JC, Fang J, Silver FL. Acute ischemic stroke and abnormal blood hemoglobin concentration. *Acta Neurologica Scandinavica.* 2016 Aug;134(2):123-30.
13. Barlas RS, Honney K, Loke YK, McCall SJ, Bettencourt-Silva JH, Clark AB, et al. Impact of hemoglobin levels and anemia on mortality in acute stroke: analysis of UK regional registry data, systematic review, and meta-analysis. *J Am Heart Associa.* 2016 Aug 17;5(8):e003019.

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