

Association between malnutrition and stroke

Aditya Batlajery¹, Esdras Ardi Pramudita², Sugianto², Rizaldy Taslim Pinzon^{*2}

¹Undergraduated Student, Faculty of Medicine, Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

²Department of Neurology, Faculty of Medicine, Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

Original Article

ABSTRACT

ARTICLE INFO

Keywords:

stroke,
malnutrition,
undernutrition,
total lymphocyte count

*Corresponding author:

drpinzon17@gmail.com

DOI: 10.20885/JKKI.Vol10.Iss1.art9

History:

Received: September 11, 2016

Accepted: February 27, 2019

Online: April 30, 2019

Copyright ©2019 Authors.
This is an open access article
distributed under the terms
of the Creative Commons At-
tribution-NonCommercial 4.0
International Licence (<http://creativecommons.org/licenses/by-nc/4.0/>).

Background: Stroke is a serious health problem that is characterized by high morbidity and mortality. One of the risk factors for stroke able to be controlled is malnutrition (undernutrition). Malnutrition can be assessed by Total Lymphocyte Count (TLC) if a low TLC value is found or less than 1500 cells/mm³. Undernutrition increases the risk of cerebrovascular disease. Lack of substances such as vitamins can affect brain blood vessels.

Objective: To determine the relationship of malnutrition assessed according to the parameter of Total Lymphocyte Count (TLC) to stroke.

Methods: This study used a cross-sectional research method. The sample was obtained from the medical record data of the patient in the nerve polyclinic at Bethesda Hospital, Yogyakarta. The sample size in this study was 210 medical records consisting of 105 stroke patients and 105 non-stroke patients. Data from medical records obtained were analyzed by computerization and tested by univariate analysis followed by bivariate analysis with chi-square test.

Results: In this study, the description of sex showed that the majority were male patients by 119 (56.7%), while female patients were 91 (43.3%). The most age ranges in this study were aged 60-69 years and over 70 years, each of which was 64 (30.5%). The most common risk factor was hypertension with 131 patients (62.4%). In the statistical analysis it was found that hypertension showed a significant relationship (RP: 4.85, 95% CI: 2.62-8.97, p: 0.000), and it was the strongest variable related to stroke. Statistical malnutrition did not have a significant relationship to the incidence of stroke (Rp. 0.80, 95% CI: 0.32-2.00, p: 0.644).

Conclusion: Generally, malnutrition does not show a significant relationship to stroke. Hypertension is an independent risk factor for stroke.

Latar Belakang: Stroke merupakan salah satu masalah kesehatan serius yang ditandai dengan morbiditas dan mortalitas yang tinggi. Salah satu faktor risiko stroke yang dapat dikendalikan adalah keadaan malnutrisi (undernutrition). Keadaan malnutrisi dapat dinilai dengan Total Lymphocyte Count (TLC) jika didapati nilai TLC yang rendah atau kurang dari 1500 sel/mm³. Undernutrition meningkatkan risiko terjadinya penyakit serebrovaskular. Kekurangan zat-zat seperti vitamin, dapat berdampak bagi pembuluh darah otak.

Tujuan: Penelitian ini bertujuan untuk mengetahui hubungan malnutrisi yang dinilai berdasarkan parameter Total Lymphocyte Count (TLC) dengan kejadian stroke.

Metode: Penelitian ini menggunakan metode penelitian cross-sectional. Sampel didapatkan dari data rekam medis pasien poliklinik saraf Rumah Sakit Bethesda Yogyakarta. Besar sampel pada penelitian ini sebanyak 210 rekam medis yang terdiri dari 105 pasien stroke dan 105 pasien non stroke. Data dari rekam medis

yang diperoleh dianalisis secara komputerisasi dan diuji dengan analisis univariat yang kemudian dilanjutkan dengan analisis bivariat dengan uji chi-square.

Hasil: Pada penelitian ini gambaran jenis kelamin menunjukkan sebagian besar adalah pasien laki-laki sebesar 119 (56,7%), sedangkan pasien perempuan sebesar 91 (43,3%). Rentang usia paling banyak pada penelitian ini ada di usia 60-69 tahun dan di atas 70 tahun, masing-masing sebanyak 64 (30,5%). Faktor risiko yang sering terjadi adalah hipertensi dengan jumlah 131 pasien (62,4%). Pada analisis statistik didapatkan bahwa hipertensi menunjukkan hubungan signifikan (RP: 4,85, 95%CI: 2,62-8,97, p: 0,000) dan merupakan variabel terkuat yang berhubungan dengan kejadian stroke. Malnutrisi secara statistik tidak memiliki hubungan yang signifikan terhadap kejadian stroke (RP: 0,80, 95%CI: 0,32-2,00, p: 0,644).

Kesimpulan: Malnutrisi secara umum tidak menunjukkan hubungan yang signifikan terhadap kejadian stroke. Hipertensi merupakan faktor risiko independen terjadinya stroke.

INTRODUCTION

Stroke is a focal (or global) brain disorder caused by vascular disorders, with clinical symptoms that takes place 24 hours or more.¹ The morbidity and mortality rates of this disease are quite high. The incidence of stroke tends to increase annually. Epidemiological data show that stroke is the second cause leading death in the world after heart disease. In countries with low capita income, stroke is the sixth cause of death, whereas, in countries with moderate and high capita income, it is the second leading cause of death.¹

Malnutrition in a person's body will cause various health problems. It can lead to anaemia, reduce the body's resistance to disease, and even cause death. Also, malnutrition in children can lead to blindness and failure to thrive.²

There several studies showing that people with malnutrition have a higher risk of stroke. Body Mass Index (BMI). Women with the nutritional status that is less or thin with body mass index (body mass index / BMI) <20 kg/m² have a higher risk of a hemorrhagic stroke compared to other women with a BMI of 20.0–

22.9 kg/m². Furthermore, low cholesterol levels are also thought to increase the risk of hemorrhagic stroke.³

The condition of malnutrition laboratory is also indicated by the low total lymphocyte level in the blood. Calculation of TLC is obtained from the percentage of lymphocytes in percent, then multiplied by the number of leukocytes (White Blood Count) and the multiplication result is divided by 100.⁴ Previous researchers by Chandra et al. 1991 found a significant correlation between malnutrition and TLC <1200 cells/mm³ and between severe malnutrition and TLC <900 cells/mm³. Malnutrition is associated with a decrease in body mass, including thymus gland atrophy causing lymphopenia.⁵ The mechanism of lymphocyte reduction in malnutrition up to the present has not been clearly described, but it is thought to be associated with atrophy of the thymus gland and interleukin.

Undernutrition increases the risk of cerebrovascular disease. Lack of substances such as vitamins may impact on brain blood vessels.⁶ Solenski (2007) wrote that the relationship between nutrition and cerebrovascular disease was in the lack of intake of vitamins B₁₂, B₆, B₁₂, folic acid leading to hyperhomocysteinemia and blood cell formation disorders.⁷

This study aims to determine the relationship of malnutrition assessed according to the parameters of Total Lymphocyte Count (TLC) to stroke.

METHODS

This study was conducted for three months (July-September 2014) in Neural Unit and Medical Record Section of Bethesda Hospital Yogyakarta. This study obtained ethical research approval from the Medical Research Ethics Commission of the Faculty of Medicine, Duta Wacana Christian University with no 061/C.10/FK/UKDW/VI/2014. This study used a cross-sectional method, and research data was taken through the patient's medical record.

The inclusion criteria in this study are all male and female stroke patients diagnosed by a neurologist, and aged more or equal to 40 years.

Exclusion criteria in this study are previous stroke patients, patients who have leukemia, patients with a history of chemotherapy and chronic diseases such as aplastic anaemia, myelodysplasia syndrome, HIV-AIDS, systemic lupus erythematosus (SLE)

In the control group, the inclusion criteria are all patients in the nerve poly suffering from non-cerebrovascular disease and aged more or equal to 40 years. Then, exclusion criteria are patients who have leukemia, patients with a history of chemotherapy and chronic diseases such as aplastic anemia, myelodysplasia syndrome, HIV-AIDS, systemic lupus erythematosus (SLE).

From the inclusion criteria, 210 research subjects were meeting the research criteria,

consisting of 105 patients with the case of both infarct and ischemic stroke diagnosis and 105 control patients with the non-cerebrovascular diagnosis. Patients with a stroke diagnosis (ischemic or hemorrhagic) are clinically determined, and a picture of infarction or cerebral haemorrhage is obtained on the CT scan results recorded in the medical record. This study uses a cross-sectional method

The data is taken using the data retrieval form. The dependent variable in this study is stroke, and the independent variable in this study is the value of Total Lymphocyte Count (TLC) for assessment of malnutrition while confounding variables include patient age, gender, education level, history of hypertension,

Table 1. Characteristics of research subjects

	n	(%)
Sex		
Males	119	56.7
Females	91	43.3
Age		
40-49 years old	26	12.4
50-59 years old	56	26.7
60-69 years old	64	30.5
>70 years old	64	30.5
Previous Education		
<Elementary School	22	10.5
Elementary School	29	13.8
Junior High School	26	12.4
Senior High School	70	33.3
College	39	18.6
History of hypertension	131	62.4
History of Diabetes Mellitus	42	20.0
History of hypercholesterol (mg/dL)	91	43.3
High LDL history (mg/dL)	125	59.5
Total Leukocytes (thousand/mm ³)	-	-
Lymphocyte (%)	-	-
Total Lymphocyte Count (cell/mm ³)	-	-
Severe malnutrition (<900)	22	10.5
Moderate malnutrition (900-1500)	66	31.4
Non malnutrition (>1500)	122	58.1

hypercholesterolemia, LDL levels and a history of diabetes mellitus.

The data from medical records obtained are analysed by computerisation and tested by a univariate analysis which is then continued with bivariate analysis with chi-square test and multivariate with logistic regression test.

RESULTS

The subjects of this study are mainly males (119 people / 56.7%) graduating from senior high schools the last education (33.3%). The subjects of this study are mainly in the age range of 60-69 years and over 70 years (64 people /

30.5% respectively). The main risk factor found in the study is hypertension (131 patients/ 62.4%).

Based on the results of the analysis using Chi-square there are two variables that show a significant relationship to stroke ($p < 0.05$). Both of these factors are hypertension (OR: 4.85, 95% CI: 2.62-8.97, $p = 0.000$) and low education (elementary school education, OR: 0.18, 95% CI: 0.05 -0.60, $p = 0.005$). The other variables such as gender, age, diabetes mellitus, hypercholesterolemia, high LDL history and TLC do not have a statistically significant association with stroke.

Table 2. Basic Characteristics of Stroke and Non-Stroke Patients

	Stroke		Non Stroke	
	N	%	N	%
Sex				
Males	59	56,2	59	56.2
Females	46	43,8	46	43.8
Age				
40-49 years old	13	12,4	13	12.4
50-59 years old	28	26,7	28	26.7
60-69 years old	32	30,5	32	30.5
>70 years old	32	30,5	32	30.5
Previous Education				
<Elementary School	17	16,2	5	4.8
Elementary School	11	10,5	18	17.1
Junior High School	12	11,4	14	13.3
Senior High School	35	33,3	35	33.3
College	15	14,3	24	22.9
History of hypertension	84	80,0	47	44.8
History of Diabetes Mellitus	20	19,0	22	21.0
History of hypercholesterol (mg/dL)	57	54,3	34	32.4
High LDL history (mg/dL)	80	76,2	45	42.9
Total Leukocytes (thousand/mm ³)	-	-	-	-
Lymphocyte (%)	-	-	-	-
Total Lymphocyte Count (cell/mm ³)	-	-	-	-
Severe malnutrition (<900)	12	11,4	10	9.5
Moderate malnutrition (900-1500)	33	31,4	33	31.4
Non malnutrition (>1500)	60	57,1	62	59.0

Table 3. Bivariate Analysis stroke event

Variables		RP	95% CI	p-value
Sex	Male	0.96	0.55-1.66	0.889
	Female			
Age	45-54 years old	-	-	-
	55-64 years old	1.0	0.40-2.48	1.0
	65-75 years old	1,0	0.48-2.04	1.0
	>75 years old	1,0	0.50-2.00	1.0
Last Education	<Elementary School	-	-	-
	Elementary School	0.18	0.05-0,60	0.005*
	Junior High School	1.02	0.38-2.75	0.964
	Senior High School	0,72	0.26-1.99	0.538
	College	0,62	0.28-1.38	0.248
Hospital Chart	Hypertension	4.85	2.62-8.97	0.000*
	Diabetes Mellitus	0,80	0.40-1.61	0.546
	Hypercolesterol	1,49	0.82-2.71	0.182
	High LDL	1.68	0.80-3.53	0.166
Total Lymphocyte Count	Severe malnutrition	-	-	-
	Moderate malnutrition	0.80	0.32-2.00	0.644
	Non malnutrition	0.96	0.53-1.76	0.915

OR: odd ratio, CI: confident interval

DISCUSSION

This study showed that strokes occur more in men than in women. This is in accordance with Appelros et al. (2009) which showed that the incidence and prevalence of stroke throughout the world proved to be higher in men than in women.⁸ The incidence of stroke varies from all age ranges, but 75% of strokes strike in patients over 65 years of age.⁷ The same thing was shown in this study. As many as 60 % of research subjects who had a stroke had ages between 60-69 years and over 70 years. However, this study did not find a statistically significant relationship between sex, age and stroke.

Diabetes mellitus causes blood fat levels to increase since the conversion of body fat is disturbed resulting in atherosclerosis. Research by Idris et al. (2005) stated that the pathophysiology of diabetes increased the risk of stroke. Hypercholesterolemia is associated with the onset of atherosclerosis which can increase the risk of stroke.⁹ In this study, cholesterol and

LDL levels were not associated with stroke. In line with research in the Framingham Study by Pearson et al. (2002), it stated that there was no relationship between total cholesterol and stroke in both men and women.

Hospital chart such as diabetes mellitus, high cholesterol and LDL levels does not have a statistically significant relationship with stroke. The results in this study did not prove possible because the hospital chart had already been controlled through drug consumption, wherein this study the duration of sickness and the drugs consumed were not taken into account.

Hypertension plays a role in atherosclerosis process through the effect of suppression of endothelial cells or the lining of the arterial wall which results in the formation of blood vessel plaques. Hypertension increases the development of atherosclerotic plaques in the cerebral arteries and arterioles which will cause arterial occlusion and ischemic injury which increases the risk of stroke.⁷ The theory

of previous research supports the results of this study that found a statistically significant relationship between hypertension and stroke with RP 4.85 (95% CI: 2.62-8.97) and $p=0.000$. Hypertension is the most influential risk factor for stroke and is an independent factor because it has a value of $p=0,000$.

Education is one of the factors that indirectly play a role in stroke. It is someone's effort to obtain more information and knowledge that will affect his health behaviour. The results of this study indicated that the majority of stroke patients graduated from senior high school education as the previous education (33.3%). The results of the bivariate analysis showed that the last education especially elementary school (Rp. 0.18, 95% CI: 0.05-0.60, $p: 0.005$) had a statistically significant relationship with stroke. Notoatmodjo (2007) in his paper revealed that education was one of the factors that indirectly played a role in stroke because it was as someone's effort to obtain information and knowledge expected in the future would change health behaviour to be better. Someone with a higher level of education is expected to be able to understand health information and apply it in daily life.

Gunarsa et al. (2011) showed that there was a significant relationship between malnutrition and TLC levels (TLC $<1,200$ cells/mm³). Severe malnutrition shows TLC <900 cells/mm³.¹² In this study malnutrition conditions (indicated by low TLC levels) did not show a significant relationship with stroke which is different from the research of Kurth et al. (2005) showing that women in the thin BMI category or included in the possible undernutrition category (<20 kg / m²) are at higher risk of hemorrhagic stroke than women with a BMI of 20.0 - 22.9 kg / m². Also, low cholesterol levels are also thought to be associated with the increase of hemorrhagic stroke.³

The results of this study appear to be in line with the research of Bazzano et al. (2011) which showed that both men and women with undernutrition (low BMI) have a low potential for stroke.¹³ The same thing was confirmed by

Wang et al., (2013). The situation of overnutrition (obesity) is an independent risk factor for stroke, while the condition of undernutrition has a low potential for stroke

There is no meaningful relationship between low TLC levels and stroke in this study probably due to the occurrence of an inflammatory process which is a risk factor for atherosclerosis in stroke patients. Acute and chronic inflammatory processes cause an increase in lymphocyte and leukocyte levels in stroke patients. Therefore, assessing malnutrition using low TLC parameters in stroke patients is not appropriate to use. This seems to be a deficiency in this study. The use of BMI parameters with stroke is more relevant to find out the relationship between nutritional status and stroke because the parameters of BMI are not related to the components of blood cells such as lymphocytes and leukocytes which tend to increase in stroke.

Malnutrition cannot be a risk factor alone to cause a stroke. Malnutrition conditions need to be supported by other independent risk factors such as hypertension to increase the risk of stroke. Lack of intake of vitamins B₁₂, B₆ and folic acid can lead to hyperhomocysteinemia. Hyperhomocysteinemia conditions can increase the risk of stroke. Vitamin C deficiency can increase the broken blood vessels. If the blood vessels in the brain have ruptured, there will be a stroke condition in patients.⁶

CONCLUSION

Based on the results of this study it can be concluded that there is no relationship between Total Lymphocyte Count and stroke.

This study was conducted to determine the relationship of malnutrition with stroke assessed by the parameter Total Lymphocyte Count (TLC) that has never been done in previous studies.

Further research can be done with different research methods, for example by cohort methods and with more sample sizes. Unrelated risk factors can also be continued.

CONFLICT OF INTEREST

None declare.

Acknowledgement

None declare.

REFERENCES

1. World Health Organization (WHO). Fact Sheet: The Top Ten Causes of Death, World Health Organization. 2008;
2. World Health Organization (WHO). WHO World Atlas on CVD/Stroke, World Health Organization. 2004.
3. Kurth T, Gaziano JM, Rexrode KM, Kase CS, Cook NR, Manson JE, et al. Prospective Study of Body Mass Index and Risk of Stroke in Apparently Healthy Women. *Circulation*. 2005;111:1992–8.
4. Nasar, S.S., Prawitasari, T., Lestari, E.D., Djais, J., Susanto J. Skrining Malnutrisi pada Anak yang Dirawat di Rumah Sakit [Internet]. 2007. Available from: buk.depkes.go.id/index
5. Chandra RK. Nutrition and Immunity : lessons from the past and new insights form the future. *The American Journal of Clinical Nutrition*. 2018;53(March):1087–101.
6. Jauhari A, Nasution N. *Nutrisi dan Keperawatan*. Yogyakarta: Jaya Ilmu; 2013. 110-120 p.
7. Solenski NJ. Emerging Risk Factors for Cerebrovascular Disease. *Current Drug Targets*. 2007;8(7):802–16.
8. Appelros P, Stegmayr B, Terent A. Sex Differences in Stroke Epidemiology. *Stroke*. 2009;40:1082–90.
9. Idris I, Thomson GA, Sharma JC, Pease J, Centre D. Diabetes mellitus and stroke. *The International Journal Of Clinical Practice*. 2006;60(1):48–56.
10. Pearson TA, Blair SN, Daniels SR, Eckel RH, Fair JM, Fortmann SP, et al. AHA Scientific Statement AHA Guidelines for Primary Prevention of Cardiovascular Disease and Stroke: 2002 Update. *Circulation*. 2002;113:388–91.
11. Notoatmodjo S. *Promosi Kesehatan dan Ilmu Perilaku*. Jakarta: Rineka Cipta; 2007.
12. Bazzano LA, Gu D, Whelton MR, Wu X, Chen C, Duan X, et al. Body Mass Index and Risk of Stroke among Chinese Men and Women. *Annals of Neurology*. 2010;67:11–20.
13. Wang C, Liu Y, Yang Q, Dai X, Wu S, Wang W, et al. Body mass index and risk of total and type-specific stroke in Chinese adults : results from a longitudinal study in China. *International Journal of Stroke*. 2013;8(June):245–50.