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Neutrophil Lymphocyte Ratio as a Predictor of Short-term Mortality in Acute Ischaemic Stroke

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Abstract **Original Research Article**

Background: Acute ischaemic stroke (AIS) is a leading cause of mortality and disability worldwide, with early mortality being a critical concern. Inflammation plays a pivotal role in the pathophysiology of AIS, influencing outcomes. The neutrophil-lymphocyte ratio (NLR), a readily available marker of systemic inflammation, has emerged as a potential predictor of stroke prognosis. This study aimed to evaluate the role of NLR in predicting short-term mortality among AIS patients. ***Methods:*** This prospective study was conducted in the Department of Medicine & Department of Neurology in Dhaka Medical College Hospital, Dhaka, Bangladesh from February 2018 to July 2018. A total of 384 participants suffering from acute ischaemic stroke (AIS) who were admitted to the hospital within 24 hours of onset were enrolled as the study subjects purposively. Data were analyzed using SPSS version 23.0. ***Results:*** In this study of 100 acute ischaemic stroke patients, the mean age was 60.71±11.19 years. Eighteen percent of patients died within 30 days' post-stroke. Mortality was significantly associated with higher WBC, neutrophil count, NLR, RBS, and TG, and lower lymphocyte count ($p<0.05$). Logistic regression analysis showed that each unit increase in NLR, along with hypertension, diabetes, and dyslipidemia, significantly increased the odds of 30-day mortality ($p<0.05$). ***Conclusion:*** In acute ischaemic stroke patients, an elevated neutrophil lymphocyte ratio (NLR) is a significant predictor of 30-day mortality. NLR, along with comorbidities such as hypertension, diabetes, and dyslipidemia, can help identify high-risk patients for better management.

Keywords: Acute, Ischaemic stroke, Nerve palsy, Neutrophil lymphocyte ratio, Predictor, Short-term mortality.

INTRODUCTION

Stroke incidence and mortality are notably rising in less developed countries [1]. The World Health Organization (WHO) estimates that 86% of stroke-related deaths globally occur in these nations [2], with South Asia being a significant contributor, potentially accounting for over 40% of global stroke fatalities [3]. Bangladesh ranks 84th in the world for stroke-related mortality, according to the WHO. Alarmingly, the stroke mortality rate in Bangladesh increased from 6.00% in 2006 to 8.57% in 2011, with an age-adjusted mortality rate of 108.31 per 100,000 people in 2011 [4]. Globally, the average 30-day case fatality following a first ischemic stroke is approximately 22.9%, with notable exceptions in countries like Japan (17%) and Italy (33%) [5]. In the United States, cardiovascular events account for 22% of deaths following ischemic stroke [6]. The primary cause of most acute strokes (85–90%) is compromised vascular supply to the brain. Emerging evidence highlights the pivotal role of an inflammatory process in the development and progression of atherosclerosis, a key factor underlying the pathogenesis of cerebral and cardiac ischemia [7]. This inflammatory response begins within 6–24 hours of ischemic injury and is crucial in the extent of ischemic damage [8]. As part of the initial response to ischemic brain injury, Neutrophils migrate to the affected area, accumulate in the ischemic and reperfused regions, and release proteolytic enzymes like acid phosphatase and reactive oxygen species, exacerbating the damage [9]. Neutrophils significantly influence infarct volume [10],

with evidence showing that higher neutrophil counts correlate with larger infarct sizes and increased mortality [11]. This relationship is particularly critical, as larger infarct volumes are associated with poorer outcomes in ischemic stroke patients. Leukocyte count is recognized as an independent predictor of cardiovascular events and all-cause mortality in long-term follow-ups, although the underlying mechanisms remain unclear. Previous studies have demonstrated that an elevated neutrophil-to-lymphocyte ratio (NLR) is linked to increased mortality and morbidity in patients with acute myocardial infarction [12]. Recent investigations into the effects of NLR on mortality and morbidity in acute ischemic stroke have identified NLR as a reliable predictor of short-term mortality in these patients [10,11].

METHODOLOGY

This prospective study was conducted in the Department of Medicine and Department of Neurology at Dhaka Medical College Hospital, Dhaka, Bangladesh, from February 2018 to July 2018. A total of 384 participants diagnosed with acute ischaemic stroke (AIS) were enrolled. All patients were admitted to the hospital within 24 hours of symptom onset. A purposive sampling technique was used for sample selection.

Inclusion Criteria:

Patients aged >18 years of both genders, diagnosed with AIS within 24 hours of symptom onset, and willing to participate in the study were included.

Exclusion Criteria:

Patients admitted >24 hours after symptom onset, those with known bleeding disorders, patients on immunosuppressant drugs, those with a history of infection within the last two weeks, a history of stroke within six months, malignancy, or those requiring intensive care unit (ICU) support were excluded.

AIS was defined following the World Health Organization (WHO) criteria as 'a clinical syndrome consisting of rapidly developing symptoms and signs of focal (or global in the case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than vascular origin' [13]. Ethical approval for the study was obtained from the ethical committee of Dhaka Medical College Hospital. Data analysis was performed using SPSS version 23.0, ensuring the systematic interpretation of findings.

RESULT

In this study, total 100 patients of acute ischemic stroke were included. Mean age was 60.71±11.19 years, ranging from 35 to 83 years. Majority patients (39%) belonged to age group (61-70 years). It was observed that the majority of cases (64%) were male and rest of cases (36%) were female. As the clinical presentation of patients, most common clinical presentation was weakness of one side of body (100%), limb weakness (100%) and bladder dysfunction (100%). Weakness was left sided in 50% patients, right sided another 50%. Ninety-four percent had hemiparesis, 72% patients had one or more upper motor neuron type cranial nerve palsy, 60% had dysphasia, 32% had altered consciousness and 17% had convulsion. In our study, it was found that more than half of cases (56%) were hypertensive, followed by history of smoking 39%, history of alcohol intake 6%, diabetic 24% and dyslipidemia 40%. A total 18% patients died within 30 days after stroke event. Rest 82% patients survived. WBC count, neutrophil count, neutrophil lymphocyte ratio (NLR), RBS and TG was statistically significantly higher among patients who died within 30 days ($p<0.05$). Lymphocyte count was significantly lower in this group of patients($p<0.05$). Distribution of total cholesterol, LDL and HDL was similar across groups ($p>0.05$). Univariate logistic regression analysis showed that stroke patients with hypertension, diabetes, dyslipidemia and one-unit increase in NLR was associated with significantly higher odds of dying within 30 days after stroke. Multivariate logistic regression analysis showed that when adjusted for age, sex, smoking habit, alcohol intake, presence of hypertension, diabetes and dyslipidemia one-unit increase in NLR was associated with significantly higher odds of dying within 30 days after stroke ($p<0.05$).

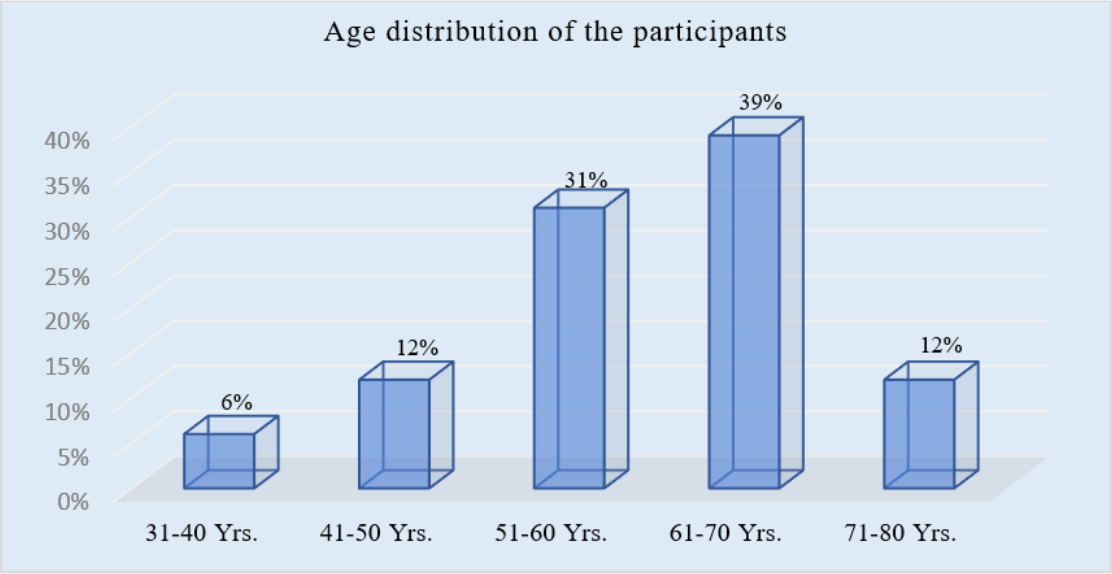

Figure I: Column chart showed age wise *participants* distributions (N=384)

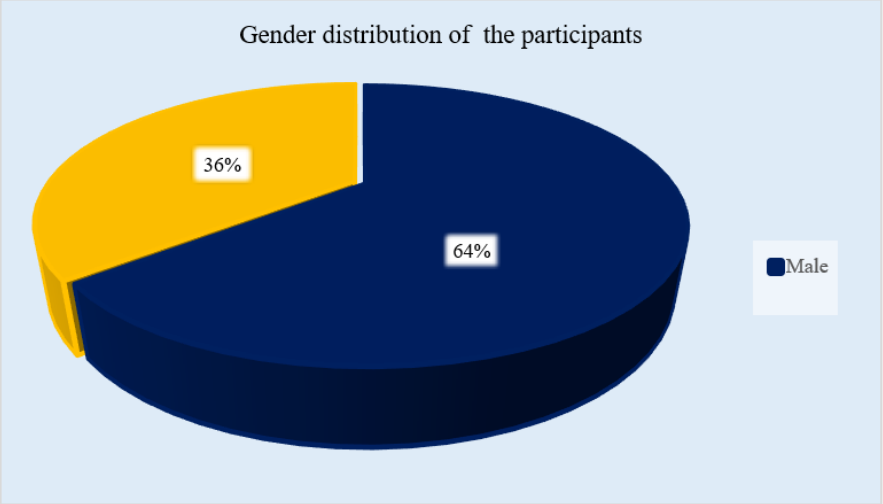

Figure II: Pie chart showed gender wise *participants* distributions (N=384)

Table 1: Clinical presentation of patients

Clinical presentation	n	%
Body-weakness of one-side	100	100%
Left-sided weakness	50	50%
Right-sided weakness	50	50%
Limb weakness	100	100%
Hemiparesis	94	94%
Monoparesis	6	6%
Sensory loss	22	22%
Nerve palsy	72	72%
Altered consciousness	32	32%
Convulsion	17	17%
Visual disturbance	6	6%
Dysphasia	60	60%
Bladder dysfunction	100	100%
Retention	50	50%
Incontinence	50	50%
Headache	27	27%
Vomiting	15	15%

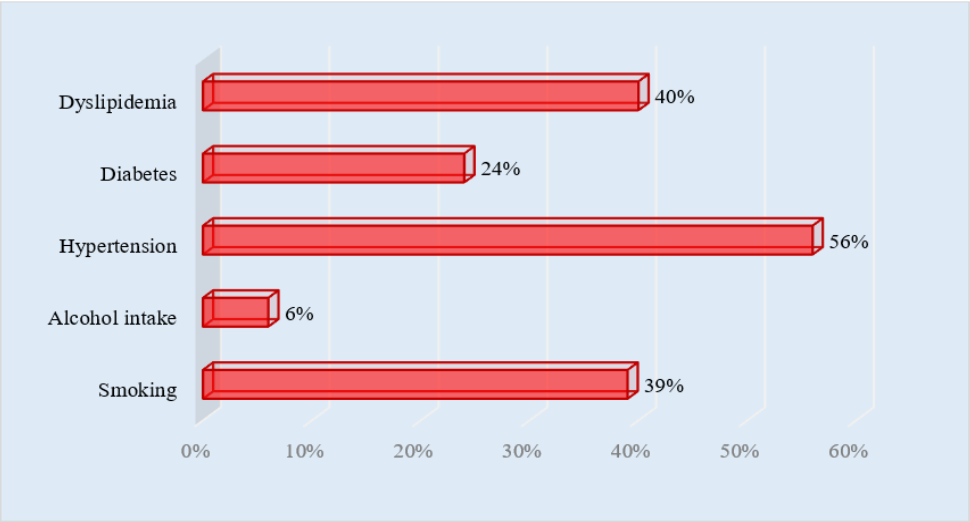

Figure III: Bar chart showed distribution of risk factors of stroke (N=384)

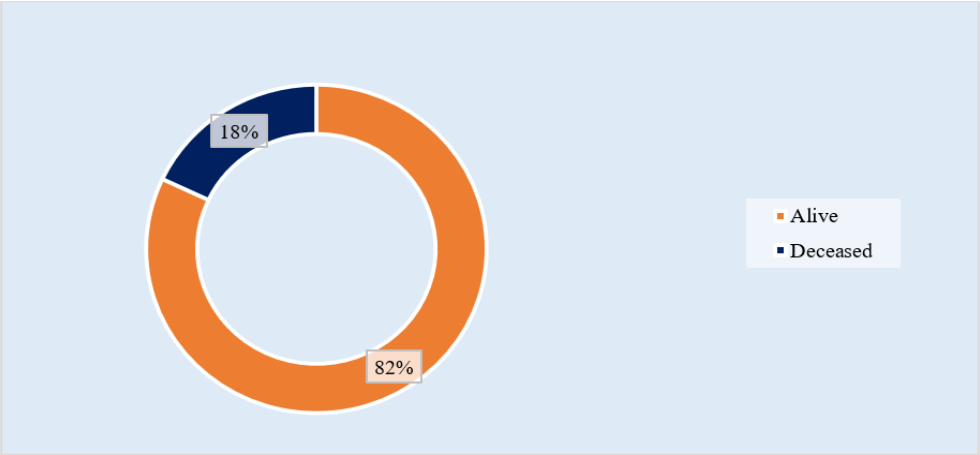

Figure IV: Ring chart showed outcome of 30 days after the event (N=384)

Table 2: Investigation profile of patients (N=384)

Profile	Alive	Dead	p-value
WBC (10^3/µl)	11.24±2.67	13.99±2.35	<0.001
N (103/µl)	7.75±2.59	11.70±1.68	<0.001
L (103/µl)	2.17±0.65	1.06±0.78	<0.001
NLR	3.84±1.63	16.12±9.14	<0.001
RBS (mmol/L)	5.42±1.92	9.20±3.66	<0.001
TC (mg/dl)	175.37±36.2	195.67±52.7	0.135
LDL (mg/dl)	98.28±30.25	104±19.97	0.446
HDL (mg/dl)	47.70±11.52	43.28±10.15	0.136
TG (mg/dl)	147.00±71.1	242.06±167.2	0.026

Table 3: Univariate logistic regression for odds of dying within 30 days after stroke

Factors	Odds Ratio	95% CI		p-value
Age >60 years	2.2	0.75	6.43	0.148
Male gender	2.58	0.9	7.36	0.076
Smoking	1.32	0.47	3.69	0.602
Alcohol intake	5.26	0.97	28.62	0.054
Hypertension	3.33	1.01	10.98	0.048
Diabetes	6.07	2.04	18.12	0.001
Dyslipidemia	2.87	1	8.21	0.049
NLR	2.65	1.52	4.63	0.001

Table 4: Multivariate logistic regression for odds of dying within 30 days after stroke

Factors	Odds Ratio	95% CI		p-value
Age >60 years	73.53	0.21	25785.02	0.151
Male sex	47.77	0.13	17365.69	0.199
Smoking	2.13	0.01	349.44	0.771
Alcohol intake	0.27	0	2242.47	0.778
Hypertension	1.25	0.05	32.78	0.895
Diabetes	7.83	0.34	183.12	0.201
Dyslipidemia	6.51	0.23	184.91	0.273
NLR	4.63	1.04	20.58	0.044

DISCUSSION

In this study, the mean age of the patients was 60.71 ± 11.19 years, which is consistent with the findings of Bhowmik *et al.*, [14], who reported a mean age of 60.6 years in a study of over six hundred acute ischemic stroke patients in Bangladesh. The majority of patients in this study belonged to the 61–70 year's age group (39%), aligning with findings by Jannat *et al.*, [15], who reported that 36% of patients fell within the same age range. Age-related changes in the brain are known to increase vulnerability to ischemic stroke in the elderly [16]. Among the study population, 64% were male and 36% were female, yielding a male-to-female ratio of 1.7:1. Similar findings were reported by Bhowmik *et al.*, [14], who observed 67.7% male and 32.3% female patients, and by Sharmin [17], who found 64% male and 36% female participants in their study. In this study, 60% of patients presented with dysphasia, and 32% had altered consciousness. Similarly, Siddique *et al.*, [18] reported that among ischemic stroke patients, 80% had hemiplegia or hemiparesis, 60% had dysphasia, and 53.75% had impaired consciousness, findings that are nearly similar to this study. Regarding lifestyle factors, 39% of the patients in this study were smokers, and 6% were alcoholics. In comparison, Bhowmik *et al.*, [14] reported that 30.5% of stroke patients in Bangladesh were smokers, while Mahanta *et al.*, [19] observed 28.1% current smokers and 24% current alcoholics in a study conducted in northeastern India. Among all participants, the prevalence of diabetes was 24%, which aligns closely with the findings of Siddiqui *et al.*, [20], who reported diabetes in 22% of their study population. Hypertension was observed in 56% of the patients, a prevalence similar to that reported by Renjen *et al.*, [21], who found 56.9% of stroke patients with hypertension in their study. Dyslipidemia was present in 40% of the patients in this study. This prevalence is higher than the 20% reported by Siddiqui *et al.*, [20] but lower than the 93% reported by Bhowmik *et al.*, [14]. The discrepancy may stem from differences in the criteria or methods used to define and diagnose dyslipidemia in these studies. In this study, patients were followed up 30 days after the stroke event, and 18% of them died within this period. This mortality rate is lower than the findings of Femi and Mansur [22], who reported a 37% one-month mortality rate. However, their study included both hemorrhagic and ischemic stroke patients, with 69.6% of the deaths occurring in hemorrhagic stroke cases and 30.4% in ischemic stroke cases. Based on their data, approximately 12% of ischemic stroke patients died within one month, which is lower than the mortality rate observed in the present study. On the other hand, the mortality rate in this study is higher than the 7.5% to 14.3% thirty-day mortality rates reported by Thompson *et al.*, [23]. However, it is lower than the findings of Tokgoz *et al.*, [24], who observed a 27.8% mortality rate among stroke patients within 60 days. These variations in mortality rates may result from differences in study populations, healthcare access, treatment protocols, and the severity of the strokes included in the respective studies. In this study, patients were followed up 30 days after the stroke event, and 18% of them died within this period. This mortality rate is lower than the findings of Femi and Mansur [22], who reported a 37% one-month mortality rate. However, their study included both hemorrhagic and ischemic stroke patients, with 69.6% of the deaths occurring in hemorrhagic stroke cases and 30.4% in ischemic stroke cases. Based on their data, approximately 12% of ischemic stroke patients died within one month, which is lower than the mortality rate observed in the present study. 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populations, healthcare access, treatment protocols, and the severity of the strokes included in the respective studies.

CONCLUSION AND RECOMMENDATION

In this study, NLR was assessed among hundred patients with acute ischemic stroke. It is found that male and higher age predominantly suffered from ischemic stroke. Analysis showed that to predict this patient groups NLR could be used as a newer tool supported by higher ratio of it was associated with short term mortality. Because of the routine use and inexpensive nature of hemogram analysis, the NLR should be investigated in future studies of acute stroke patients. Depending upon the study findings, NLR may be used as a predictor of outcome of acute ischaemic stroke.

REFERENCES

1. Ovbiagele B, Nguyen-Huynh MN. Stroke Epidemiology: Advancing Our Understanding of Disease Mechanism and Therapy. Neurotherapeutics. 2011; 8(3): 319-29.
2. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. Lancet Neurol. 2009; 8(4): 355-69.
3. Wasay M, Khatri IA, Kaul S. Stroke in South Asian countries. Nat Rev Neurol. 2014; 10(3): 135-43.
4. Islam MN, Moniruzzaman M, Khalil MI, Basri R, Alam MK, Loo KW, et al. Burden of stroke in Bangladesh. Int J Stroke. 2013; 8(3): 211-13.
5. Feigin VL, Lawes CM, Bennett DA, et al. Stroke epidemiology: a review of population- based studies of incidence, prevalence, and case-fatality in the late 20th century. Lancet Neurol. 2003; 2(1): 43-53.
6. Petty GW, Brown RD Jr, Whisnant JP, et al. Survival and recurrence after first cerebral infarction: a population-based study in Rochester, Minnesota, 1975 through 1989. Neurology. 1998; 50(1): 208–16.
7. Payabvash S, Taleb S, Benson JC, McKinney AM. Acute ischemic stroke infarct topology: Association with lesion volume and severity of symptoms at admission and discharge. Am J Neuroradiol. 2017; 38(1): 58-63.
8. Clark RK, Lee EV, White RF, et al. Reperfusion following focal stroke hastens inflammation and resolution of ischemic injured tissue. Brain Res Bull. 1994; 35: 387-92.
9. Frangogiannis NG, Smith CW, Entman ML. The inflammatory response in myocardial infarction. Cardiovasc Res. 2002; 53: 31-47.
10. Tokgoz S, Keskin S, Kayrak M, Seyithanoglu A, Ogmegul A. Is Neutrophil / Lymphocyte Ratio Predict to Short-term Mortality in Acute Cerebral Infarct Independently from Infarct Volume? 2014; 23(8): 2163-8.
11. Tokgoz S, Kayrak M, Akpinar Z, Seyithanoğlu A, Güney F, Yürüten B. Neutrophil lymphocyte ratio as a predictor of stroke. J Stroke Cerebrovasc Dis. 2013; 22(7): 1169-74.
12. Tamhane UU, Aneja S, Montgomery D, et al. Association between admission neutrophil to lymphocyte ratio and Am J Cardiol. 2008; 102: 653-57.
13. Hatano S. Experience from a multicentre stroke register: a preliminary report. Bulletin of the World Health Organization. 1976; 54(5): 541-53.
14. Bhowmik NB, Abbas A, Saifuddin M, Islam MR, Habib R, Rahman A, et al. Ischemic Strokes: Observations from a Hospital Based Stroke Registry in Bangladesh. Stroke Res Treat. 2016; 2016: 1-13.
15. Jannat S, Bhowmik N, Alam D. Clinical Profile of Ischemic Stroke in Type 2 Diabetic Patients: Experience in a Tertiary Care Hospital. Birdem Med J. 2015; 5(2): 88–91.
16. Chen RL, Balami JS, Esiri MM, Chen LK, Buchan AM. Ischemic stroke in the elderly: An overview of evidence. Nat Rev Neurol. 2010; 6(5): 256-65.
17. Sharmin N, Sultana N, Rahman H, Rahman T, Chowdhury SN, Yusuf A, et al. Risk of Diabetes Mellitus in the Occurrence of Acute Ischemic Stroke at a Tertiary Care Hospital in Bangladesh. Adv Diabetes Metab. 2016; 4(3): 55-7.
18. Siddique MAN, Nur Z, Mahbub MS, Alam MB, Miah MT. Clinical presentation and epidemiology of stroke - A study of 100 cases. J Med. 2009; 10(2): 86-9.
19. Mahanta BN, Mahanta TG, Gogoi P. Clinico-epidemiological profile of stroke patients admitted in a tertiary care Hospital of Assam. Clin Epidemiol Glob Heal. 2018; 6(3): 122-9.
20. Siddiqui MR, Islam QT, Iqbal MJ, Binte-Mosharraf SS. Socio-demographic Status & Associated Risk Factors of the Stroke Patients in a Tertiary Care Hospital of Bangladesh. Anwer Khan Mod Med Coll J. 2013; 4(2): 18-22.
21. Renjen PN, Beg M, Ahmad K. Epidemiological study of incidence and risk factors of Ischemic stroke subtypes according to Trial of ORG 10172 in acute stroke treatment criteria: A 3 years, hospital-based study. Int J Med Public Heal. 2015; 5(1): 50.
22. Femi OL, Mansur N. Factors associated with death and predictors of one-month mortality from stroke in Kano, Northwestern Nigeria. J Neurosci Rural Pract. 2013; 4(5): 56.
23. Thompson MP, Zhao X, Bekelis K, Gottlieb DJ, Fonarow GC, Schulte PJ, et al. Regional Variation in 30-Day Ischemic Stroke Outcomes for Medicare Beneficiaries Treated in Get with the Guidelines-Stroke Hospitals. Circ Cardiovasc Qual Outcomes. 2017; 10(8): 1-10.
24. Tokgoz S, Kayrak M, Akpinar Z, Seyithanoğlu A, Güney F, Yürüten B. Neutrophil lymphocyte ratio as a predictor of stroke. J Stroke Cerebrovasc Dis. 2013; 22(7): 1169-74.