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## A Study Of Neutrophil To Lymphocyte Ratio And Platelet To Lymphocyte Ratio In Hypertensives And Normotensives.

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### ABSTRACT

Long-term hypertension leads to the development of atherothrombotic disease and it's a major healthcare problem worldwide. Platelets and neutrophils play an important role in Cardiovascular (CV) events and the development of atherothrombotic disease. Recently, Neutrophil/lymphocyte Ratio (NLR) and Platelet/lymphocyte Ratio (PLR), which can be easily calculated from the differential blood count, have been proposed as novel systemic inflammation-based markers predictive of thrombotic events. The present study aimed to explore the association between NLR and PLR with hypertension and as an indicator of cardiovascular risk. It's a cross-sectional study. 50 Hypertensive patients aged 40 – 60 years, males and females with a history of Previously diagnosed hypertension >1-year duration or taking anti-hypertensive medications with blood pressure Systolic BP > 140mm Hg, Diastolic BP > 90 mmHg were taken as the study group. 50 normotensives aged 40 – 60, males and females with Systolic BP < 140 mmHg and diastolic BP < 90 mmHg were taken as the control group, who were matched socio-economically with the study group. A detailed his- tory and physiological parameters were taken. Blood pressure was measured via the auscultatory method using a sphygmomanometer. Under aseptic precautions, 3 ml of venous blood samples were collected and analyzed. Neutrophil to Lymphocyte Ratio (NLR) was significantly higher ( $p<0.01$ ) in the study group. Platelet to Lymphocyte Ratio (PLR) was also higher in the study group but statistically not significant ( $p>0.05$ ). Hypertensives with higher NLR have a greater risk for atherothrombotic and atherosclerotic events.

**Keywords:** Hypertension, Neutrophil, Lymphocyte, Platelet.

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## INTRODUCTION

The rates for HT in percentage are projected to go up to 22.9% and 23.6% for Indian men and women, respectively by 2025 [1,2]. Coronary or cerebral circulation causes acute myocardial infarction or ischemic stroke and is now the single most common cause of morbidity and mortality globally, and the prevalence of these diseases continues to rise, particularly in developing nations [3]. Platelets and neutrophils play an important role in Cardiovascular (CV) events and the development of atherothrombotic disease [4,5]. Recently, Neutrophil/ Lymphocyte Ratio (NLR) and Platelet/lymphocyte ratio (PLR), which can be easily calculated from the differential blood count, have been proposed as novel systemic inflammation-based markers predictive of thrombotic events [6]. NLR inflammation and endothelial dysfunction. NLR and PLR a ratio, that are relatively more stable than individual blood parameters that can be altered by several variables [5-8.] So, our study is required to explore the association between NLR and PLR with hypertension and as an indicator of cardiovascular risk

## METHODS

The study was done at Government Medical College and Hospital, Cuddalore in the year 2023. Written informed consent was obtained from each participant before the study. Two groups were taken. 50 Hypertensive patients aged 40 – 60 years, males and females with a history of Previously diagnosed hypertension > 1-year duration, or taking anti-hypertensive medications with blood pressure Systolic BP > 140 mm Hg, Diastolic BP > 90 mmHg were taken as the study group. They were recruited from outpatient clinics of the medicine department, 50 normotensives aged 40 – 60, males and females with Systolic BP < 140 mmHg and diastolic BP < 90 mmHg were taken as the control group, who were matched socio-economically with the study group. Any systemic disease other than hypertension like Diabetes mellitus, Tuberculosis, Rheumatoid arthritis, Osteoarthritis, systemic lupus erythematosus, etc., patients using medical treatment affecting WBC count like hematopoietic disorders, treatment with chemotherapy, any present illness, acute infection in last 6 months (typhoid, malaria, pharyngitis etc.), acute coronary syndrome, etc., history of using glucocorticoid therapy within past 3 months, history of heart failure, chronic renal disease, hepatic disease, cerebrovascular disease were excluded from the study [9]. A detailed history of both hypertensives and normotensives was taken. The physiological parameters like height, weight, pulse rate, and blood pressure were taken. Blood pressure was measured in a sitting position after 5 min rest via auscultatory method using a sphygmomanometer (mercury manometer) in both arms. The higher of the two readings was taken and if the systolic and diastolic BP were in different categories, the higher of 2 was classified. General and systemic examinations were done thoroughly. 3 ml of venous blood samples were collected in EDTA accurately from the median cubital vein under aseptic precautions and analyzed by ABX MICROS 60 hematology-autoanalyzer in the hematology laboratory. BMI, pulse pressure, mean arterial pressure, neutrophil to lymphocyte ratio, and platelet to lymphocyte ratio were calculated. The data between the two groups were compared by using an unpaired t-test.  $P$  value < 0.05 was considered statistically significant. In the study group, the Correlation between blood pressure and neutrophils, lymphocytes, platelets, NLR, and PLR was found by calculating Pearson's correlation factor ( $r$ ). All statistical analyses were done in SPSS software version 17.

## RESULTS

Table 1 shows the comparison of age, height, weight, and BMI between the two groups wasn't statistically significant ( $p > 0.05$ ). Both groups were comparable to each other. Table 2 shows the pulse, systolic blood pressure, diastolic blood pressure, pulse pressure, and mean arterial pressure in the study and control groups. When compared to normotensives, Neutrophil, lymphocyte, and platelet counts were significantly higher (neutrophil- $p < 0.01$ , lymphocyte-  $p < 0.05$ , platelet- $p < 0.01$ ) in the study group (Table 3) Table 4 shows that Neutrophil to Lymphocyte Ratio (NLR) was significantly higher ( $p < 0.01$ ) in the study group. Platelet to Lymphocyte Ratio (PLR) was also higher in the study group but statistically not significant ( $p > 0.05$ ). Table 5 shows that Neutrophil counts showed a significant positive correlation with SBP ( $p < 0.01$ ), DBP ( $p < 0.01$ ), PP ( $p < 0.01$ ), and MAP ( $p < 0.01$ ). Lymphocyte counts showed a significant positive correlation with SBP ( $p < 0.01$ ), DBP ( $p < 0.01$ ), PP ( $p < 0.01$ ), and MAP ( $p < 0.01$ ). Platelet counts showed a significant positive correlation with SBP ( $p < 0.01$ ), DBP ( $p < 0.01$ ), PP ( $p < 0.05$ ), and MAP ( $p < 0.01$ ). NLR showed a significant positive correlation with SBP ( $p < 0.01$ ), DBP ( $p < 0.01$ ), PP ( $p < 0.05$ ), and MAP ( $p < 0.01$ ). PLR showed a significant positive correlation with DBP ( $p < 0.05$ ) and MAP ( $p < 0.05$ ). pressure and mean arterial pressure were significantly higher in hypertensives (Table 2) which is following the study of Pusuroglu H *et al.* who had shown Isolated systolic hypertensive and Systo-diastolic hypertensive

groups have higher SBP, DBP, and PP as compare to Nor- normotensive group [10]. Hypertension is a chronic inflammatory condition. The total white blood cell (WBC) count and its subtypes (e.g. neutrophil, lymphocyte) can be used as an indicator of systemic inflammation [11,12]. The Present study shows significantly higher Neutrophil and Lymphocyte counts in hypertensive than in Normotensive (Table 3) which follows the following studies.

Tatsukawa Y *et al.* observed a significant association between increased neutrophil counts and hypertension incidence among the Japanese population, especially in women. They concluded that neutrophils are the major WBC component contributing to the increased risk [13]. Platelets are also playing an important role in Cardiovascular (CV) events. Activated platelets stimulate thrombus formation in response to the rupture of atherosclerotic plaques or endothelial cell erosion, promoting athero-thrombotic disease [5]. The study conducted by Nadar S *et al.* showed decreased platelet counts but significantly increased mean platelet volume in hypertensive patients with end-organ damage. Mean platelet volume is a marker of platelet activation, which plays an important role in the pathophysiology of atherosclerosis [14]. The present study shows significantly higher NLR in hypertensives (Table 4) which follows the following studies. Park B *et al.* found that higher NLR was independently associated with arterial stiffness and they concluded that high NLR is an additional measure in assessing cardiovascular risk in clinical practice [15]. Sunbul M *et al.* reported that non-diabetic hypertensive has significantly higher NLR [9]. Study conducted.

**Table 1: Comparison Of Age, Height, Weight, And BMI Between Study And control Groups.**

	Study group	Control group	P value
<b>Age</b>	48.88±7.18	47.84±7.04	>0.05
<b>Height</b>	154.16±7.64	153.8±8.77	>0.05
<b>Weight</b>	67.78±10.58	65.34±6.72	>0.05
<b>BMI</b>	28.56±4.18	27.73±3.13	>0.05

**Table 2: Pulse, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse pressure, Mean Arterial Pressure In Study And Control Groups.**

	Study group	Control group	P value
<b>Pulse</b>	83.08±4.39	79.6±4.16	<0.01
<b>Systolic blood pressure</b>	146.24±6.53	119.16±3.43	<0.01
<b>Diastolic blood pressure</b>	91.56±1.95	78.4±2.09	<0.01
<b>Pulse Pressure (PP)</b>	54.68±5.21	40.76±2.61	<0.01
<b>Mean Arterial Pressure (MAP)</b>	109.79±3.27	91.98±2.31	<0.01

**Table 3: Neutrophil, Lymphocyte, And Platelet Count In Study And Control groups.**

	Study group	Control group	P value
<b>Neutrophil</b>	5977.82±1242.66	4027.9±707.76	<0.01
<b>Lymphocyte</b>	2458±712.83	2122.4±554.33	<0.05
<b>Platelets</b>	296060±85821.9	245840±52600	<0.01

**Table 4: Neutrophil to Lymphocyte Ratio (NLR) and platelet to lymphocyte ratio (PLR) in study and control groups.**

	Study group	Control group	P value
NLR	2.55±0.61	1.97±0.41	<0.01
PLR	129.25±48.49	122.51±36.49	>0.05

**Table 5: Correlation between systolic blood pressure, diastolic blood pressure, pulse pressure, and mean arterial pressure with neutrophil, lymphocytes, platelets, NLR, and PLR in the study group.**

		SBP	DBP	PP	MAP
Neutrophil	r	0.535**	0.522**	0.519**	0.530**
Lymphocyte	r	0.401**	0.368**	0.432**	0.383**
Platelet	r	0.412**	0.442**	0.324*	0.430**
NLR	r	0.414**	0.439**	0.335*	0.429**
PLR	r	0.256	0.308*	0.140	0.287*

Pearson's correlation factor

\*- Significant ( $P<0.05$ ), \*\*- Highly significant ( $P<0.01$ )

### DISCUSSION

In the present study, 50 hypertensives and 50 normotensives were taken. Age, height, weight, and blood pressure were recorded and blood samples were analyzed from all the participants. BMI was calculated from height and weight. In the present study, we found that age, height, weight, and BMI between the two groups weren't statistically significant. (Table 1) Both the groups, Hypertensives (study group) and normotensives (control group) were comparable in terms of age, height, weight, and BMI. we found pulse rate, Systolic blood pressure, diastolic blood pressure, and pulse by Pusuroglu H *et al.* had shown significantly higher NLR in isolated systolic hypertensive groups [10]. Cem O *et al.* found that NLR is a marker of chronic low-grade inflammation and plays a role in the pathogenesis of aneurysm of the ascending aorta in hypertensive patients [16]. These studies show that hypertensives have higher NLR, which has been demonstrated to have the greatest predictive power of death, myocardial infarction, and high risk for coronary artery disease and it's an independent predictor of long-term mortality [17]. Research has shown that increased PLR value without absolute thrombocytosis is associated with thrombosis and inflammation, which might be due to an increase in platelet activity [18-20]. Present study shows higher PLR in hypertensives but it's not statistically significant. (Table 4) Sunbul M *et al.* reported that PLR was significantly higher in dipper hypertensives [9]. Bayrakci N *et al.* found that PLR was significantly higher in the non-dipper hypertension group than the dipper hypertension group and they concluded that the PLR can be used in daily practice as a marker of inflammation. This study also shows that a high PLR might be indicative of high atherosclerotic risk in hypertensive patients [21]. This study shows-ing that hypertensives have higher PLR and it reflects platelet and clotting system activation, local vessel wall inflammation, and endothelial dysfunction [8]. In the present study (Table 5), Neutrophil counts show a significant positive correlation with SBP, DBP, PP, and MAP which is following the study conducted by Pusuroglu H *et al.* Lymphocyte counts showed a significant positive correlation with SBP, DBP, PP, and MAP. NLR shows a significant positive correlation with SBP, DBP, PP, and MAP. Belen E *et al.* had shown that NLR was positively correlated with SBP and DBP. Pusuroglu H *et al.* found a significant positive correlation of NLR with SBP and PP [10, 22]. In our study platelet counts showed-a significant positive correlation with SBP, DBP, PP, and MAP. PLR shows a significant positive correlation with DBP and MAP. Nowadays, interest in the study of NLR and PLR increased because absolute neutrophil and lymphocyte counts, as well as platelet counts, are easy to obtain as parts of Complete Blood Count (CBC) analysis, and their ratios are found to be predictive of the prognoses of patients with diverse inflammatory and ischemic conditions. It is a cost-effective measure, which we can apply to all patients [23, 24].

## CONCLUSION

The present study was conducted to explore the association between NLR and PLR with hypertension. We found that hypertensives have significantly higher NLR and non-significantly higher PLR as compared to normotensives. Therefore, it can be concluded that hypertensives with higher NLR have a greater risk for atherothrombotic and atherosclerotic events. NLR reflects inflammation and physiologic stress and it is relatively more stable than individual blood parameters. NLR is a reliable inflammatory index and has high predictive power to detect adverse cardiovascular events in hypertensive patients. Regarding this, we can add NLR to the routine investigating strategy for hypertensive patients to predict cardiovascular risk early and more accurately. These results can be used regularly. As our study consists of small groups, it requires to be studied on a wider scale and clinically.

## REFERENCES

- [1] Park K. Park's textbook on preventive and social medicine. 15th ed. BanarasidasBhanot. 277-8.
- [2] Raghupathy A, Nanda KK, Hira P, Hassan K, Oscar HF, Emanuele DA, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens* 2014;32(6):1170-7.
- [3] Jackson SP. Arterial thrombosis is insidious, unpredictable, and deadly. *Nat Med* 2011;17(11):1423-36.
- [4] Helene H, Carlos SR, Mat J, Esther L, Oliver S. Neutrophils in atherosclerosis: A brief overview. *Hamostaseologie* 2015;35(2):121-7.
- [5] Balta S, Ozturk C. The platelet-lymphocyte ratio: A simple, inexpensive and rapid prognostic marker for cardiovascular events. *Platelets* 2015;26(7):680-1.
- [6] Ferroni P, Riondino S, Formica V, Cereda V, Tosetto L, LaFarina F, et al. Venous thromboembolism risk prediction in ambulatory cancer patients: clinical significance of neutrophil/lymphocyte ratio and platelet/lymphocyte ratio. *Int J Cancer* 2015;136(5):1234-40.
- [7] Turfan M, Erdogan E, Tasal A, Vatankulu M, Jafarov P, Sonmez O, et al. Neutrophil-to-lymphocyte ratio and in-hospital mortality in patients with acute heart failure. *Clinics* 2014;69(3):190-3.
- [8] Oylumlu M, Ozler A, Yildiz A, Oylumlu M, Acet H, Polat N, et al. New inflammatory markers in pre-eclampsia: echocardiographic epicardial fat thickness and neutrophil to lymphocyte ratio. *Clin Exp Hypertens* 2014;36(7):503-7.
- [9] Sunbul M, Gerin F, Durmus E, Kivrak T, Sari I, Tigen K, et al. Neutrophil to lymphocyte and platelet to lymphocyte ratio in patients with dipper versus non-dipper hypertension. *Clin Exp Hypertens* 2013;36(4):217-21.
- [10] Pusuroglu H, Akgul O, Erturk M, Ozal E, Celik O, Gül M, et al. A comparative analysis of leukocyte and leukocyte subtype counts among isolated systolic hypertensive, system-diastolic hypertensive and non-hypertensive patients. *KardiologPol* 2014;72(8):748-54.
- [11] Schillaci G, Pirro M, Pucci G, Ronti T, Vaudo G, Mannarino MR, et al. Prognostic value of elevated white blood cell count in hypertension. *Am J Hypertens* 2007;20(4):364-9.
- [12] Sahin S, Sarikaya S, Akyol L, Altunkas F, Karaman K. Evaluation of Neutrophil to Lymphocyte ratio as an Indicator of Presence of Coronary Artery Disease in Diabetic Patients. *Natl J Med Res* 2013;3(4):300-3.
- [13] Tatsukawa Y, Hsu W, Yamada M, Cologne J, Suzuki G, Yamamoto H, et al. White Blood Cell Count, Especially Neutrophil Count, as a Predictor of Hypertension in a Japanese Population. *Hypertens Res* 2008;31(7):1391-7.
- [14] Yavuzkir M, Kurto lu E, Yilmaz M, Korkmaz H, Cakmak T, Dogdu O, et al. Relationship between mean platelet volume elevation and left ventricular mass index in hypertensive patients. *J Int Med Res* 2014;42(3):781-7.
- [15] Park B, Shim J, Lee H, Lee J, Jung D, Kim H, et al. Relationship of neutrophils lymphocyte ratio with arterial stiffness and coronary calcium score. *Clin Chim Acta* 2011;412(11-12):925-9.
- [16] Cem Ö, Yilmaz S, Korkmaz A, Fahrettin T, Sahin I, Demir V. Evaluation of the neutrophil-lymphocyte ratio in newly diagnosed nondiabetic hypertensive patients with ascending aortic dilatation. *Blood Press Monit* 2016;21(4):238-43.
- [17] Demir M. The relationship between neutrophil-lymphocyte ratio and non-dipper hypertension. *Clin Exp Hypertens* 2013;35(8):570-3.
- [18] Gary T, Pichler M, Belaj K, Hafner F, Gergler A, Froehlich H, et al. Platelet-to-Lymphocyte

- Ratio: A Novel Marker for Critical Limb Ischemia in Peripheral Arterial Occlusive Disease Patients. PLoS One 2013;8(7):e67688.
- [19] Yıldız A, Kaya H, Ertaş F, Oylumlu M, Bilik MZ, Yüksel M, et al. Association tween neutrophil to lymphocyte ratio and pulmonary arterial hypertension. Turk Kardiyol Dern Ars 2013;41(7):604-9.
- [20] Acar G, Kalkan M, Avci A, Alizade E, Tabakci M, Toprak C, et al. The Relation of Platelet-Lymphocyte Ratio and Coronary Collateral Circulation in Patients with Stable Angina Pectoris and Chronic Total Occlusion. Clin Appl Thromb Hemost 2013;21(5):462-8.
- [21] Bayrakci N, Ozkayar N, Akyel F, Ates I, Akyel S, Dede F. The platelet-to-lym-phocyte ratio as an inflammation marker in non-dipper hypertensive patients. Hippokratia 2015;19(2):114-8.
- [22] Belen E, Sungur A, Sungur MA, Erdoğan G. Increased Neutrophil to Lymphocyte Ratio in Patients with Resistant Hypertension. J Clin Hypertens (Greenwich) 2015;17(7):532-7.
- [23] Azab B, Shah N, Akerman M, McGinn J. Value of platelet/lymphocyte ratio as a predictor of all-cause mortality after non-ST-elevation myocardial infarction. J Thromb Thrombolysis 2012;34(3):326-34.
- [24] Alexander NI. Reference Values of Neutrophil-Lymphocyte Ratio, Platelet-Lym- phagocyte Ratio and Mean Platelet Volume in Healthy Adults in North Central Nigeria. Journal of Blood and Lymph 2016;6(1).