

# Neutrophil-lymphocyte ratio and platelet-lymphocyte ratio in hypertensive patients: A prospective cross-sectional study



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## ABSTRACT

**Background:** Long-term hypertension progresses to produce atherothrombotic disease. Chronic inflammation may contribute to epithelial dysfunction and atherogenesis and is associated with high blood pressure. Neutrophil-to-lymphocyte ratio (NLR) and platelet-lymphocyte ratio (PLR) ratios are the predictors of the cardiovascular diseases. However, studies related to this context are sparse comparatively. **Aims and Objectives:** The current study explores the NLR and the PLR with hypertension as an indicator of cardiovascular risk. **Materials and Methods:** The present study is a cross-sectional study conducted at the Department of General Medicine outpatient department, from July 2024 to August 2024. Fifty willing male and female hypertensive patients age group between 40 and 60 years were part of the study. Fifty age and gender-matched normotensive individuals were also included in the study. Blood pressure was measured using a mercury sphygmomanometer. 3 mL of venous blood was collected for complete blood count analysis. **Results:** There was no significant difference in the demographic parameters among the cases and controls. Pulse rate blood pressure and mean arterial pressure were significantly high in hypertensive patients when compared with the normotensives. Neutrophil count was significantly higher in cases than controls. The NLR was significantly higher in cases than in controls. A positive correlation was observed between the parameters. **Conclusion:** The present study results support that the NLR and PLR can be used as markers for the diagnosis of cardiovascular diseases. These tests are cost-effective and accurate. Hence, this can be implemented in the diagnosis of cardiovascular diseases. The study recommends further studies involving multiple centers and increased sample size.

**Key words:** Hypertension; Neutrophil; Lymphocyte; Platelet; Blood pressure

## INTRODUCTION

Neutrophils and platelets are involved in the inflammatory process and contribute to the development of atherothrombotic disease.<sup>1</sup> The patient with arterial hypertension has a risk of developing thrombotic events. It was reported that the neutrophils modulate the microvascular and macrovascular environment of arterial blood vessels and it may lead to oxidative stress, and produce vascular endothelial dysfunction.<sup>2</sup> Accumulation of immune cells in the blood vessels and kidney was observed in the

patients with hypertension. These accumulated immune cells are the major risk factor or pathogenesis of arterial hypertension. The activated complement system produces humoral or chemically mediated responses.<sup>3</sup> Chronic inflammation may contribute to epithelial dysfunction and atherogenesis and it has been associated with high blood pressure.<sup>4</sup> Inflammation produces mediators that regulate the responses to tissue injury. Neutrophils release free radicals which act on injured pathways of the complement system of endothelial vascular smooth muscle cells.<sup>5</sup> Lymphocytes play a pivoted role in the remodeling of

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vascular smooth muscle endothelium and proliferation of endothelium.<sup>6</sup> Neutrophil to lymphocyte ratio (NLR) is an indicator of system inflammation demonstrated to be associated with poor outcomes in various diseases including arterial hypertension.<sup>7</sup> Platelet lymphocyte ratio (PLR) will not significantly elevate in hypertensive patients as it was observed that platelets will not raise in the hypertension.<sup>7</sup> However, it was reported that in hypertensive patients there will be an alteration of the functional status of the platelets that may contribute to altered PLR. These tests are simple and comparatively less expensive. The studies in this area are relatively less. Hence, the present study was undertaken.

### Aims and objectives

The present study was undertaken to observe the neutrophil-lymphocyte ratio and platelet-lymphocyte ratio in hypertensive patients.

## MATERIALS AND METHODS

The present study is a cross-sectional study conducted at the Department of General Medicine outpatient department, from July 2024 to August 2024. The study was approved by the Institutional Human Ethics Committee (1269/2023) dated November 16, 2023. Fifty willing male and female hypertensive patients age group between 40 and 60 years were part of the study. Fifty age and gender-matched normotensive individuals were also included in the study. Willing, male and female participants within the age group of 40–60 years, duration of hypertension of more than 1 year, on antihypertensive medication with a systolic blood pressure (SBP) of more than 140 mmHg and diastolic blood pressure (DBP) of more than 90 mmHg were included in the study. The patients with any severe complications or on glucocorticoid therapy or suffering from any other diseases were excluded from the study. After a rest of 5 min, blood pressure was recorded using a mercury sphygmomanometer. three readings were taken and a higher reading was considered and noted. 3 mL of venous blood was collected for complete blood count analysis by cell counter in the hospital.

### Statistical analysis

Data were analyzed using the SPSS 21.0 version. Student-t test was used to determine the significance of the difference. Pearson's correlation coefficient was used to determine the correlation between the NLR and the PLR. A probability value of <0.05 was considered as significant.

## RESULTS

Table 1 presents the demographic data of the cases and controls. There was no significant difference among the cases and controls. Table 2 presents the pulse rate and

**Table 1: Demographic data of the cases and controls**

Parameter	Cases	Controls	P-value
Age (years)	57.4000±15.02	45.90±15.23	>0.05
Height (cm)	155.16±7.64	153.5±6.65	>0.05
Weight (kg)	68.78±10.66	66.34±6.78	>0.05
BMI (kg/m <sup>2</sup> )	28.66±3.18	27.88±2.13	>0.05

Data was expressed as mean and SD. BMI: Body mass index

**Table 2: Pulse rate and blood pressure among the cases and controls**

Parameter	Cases	Controls	P-value
Pulse rate (per min)	93.53±10.75	85.63±10.67	0.01*
Systolic blood pressure (mmHg)	162.33±27.87	111.93±8.73	0.01*
Diastolic blood pressure (mmHg)	97.33±15.07	72.33±7.73	0.01*
Pulse pressure (mmHg)	64.66±19.25	39.66±4.90	0.01
Mean arterial pressure (mmHg)	118.16±18.79	85.10±7.10	0.01

Data were expressed as mean and SD. \*P<0.05 is significant

blood pressure in cases and control groups. Pulse rate and blood pressure and mean arterial pressure (MAP) were significantly high in hypertensive patients when compared with the normotensives. Table 3 presents the neutrophil, lymphocyte, and platelet count in the study and control groups. Neutrophil count was significantly higher in cases than controls. Table 4 presents the NLR and PLR in the study group and control groups. The NLR was significantly higher in cases than in controls. Table 5 presents the correlation between SBP, DBP, and MAP with neutrophil lymphocyte, and platelet count in cases. A positive correlation was observed between the parameters.

## DISCUSSION

The study explores the NLR and the PLR with hypertension to indicate cardiovascular risk. There was no significant difference in the demographic parameters among the cases and controls. Pulse rate blood pressure and mean arterial pressure were significantly higher in hypertensive patients compared to the normotensives. Neutrophil count was considerably higher in cases than controls. The NLR was substantially higher in cases than in controls. A positive correlation was observed between the parameters. The study results are from earlier studies.<sup>8,9</sup> It was reported that a significant association exists between increased neutrophil count and hypertensive patients.<sup>9</sup> Platelets also have a role in cardiovascular diseases as the activated platelets bring the events and stimulate the formation of thrombus. Interestingly, a study reported that though platelets count is less, activated platelets are functionally different in

**Table 3: Neutrophil, lymphocyte, and platelet count in study and control groups**

Parameter	Cases	Controls	P-value
Neutrophils	5238.70±10.35	4337.90±1533.69	0.021*
Lymphocytes	2098.53±719.10	2197.53±860.43	0.631
Platelets	313300.00±114769.37	256443.33±120124.15	0.066

Data were expressed as mean and SD. \*P<0.05 is significant

**Table 4: Neutrophil lymphocyte ratio and platelet to lymphocyte ratio in the study group and control groups**

Parameter	Cases	Controls	P-value
NLR	5.75±8.09	2.506±0.86	0.0001**
PLR	166.03±8.0	146.75±40.89	0.440

Data were expressed as mean and SD. \*P<0.01 is significant. NLR: Neutrophil to lymphocyte ratio, PLR: Platelet-to-lymphocyte ratio

**Table 5: Correlation between systolic blood pressure, diastolic blood pressure, and mean arterial pressure with neutrophil lymphocyte, platelet count in cases**

Parameter	SBP	DBP	MAP
Neutrophils	0.472	0.331	0.342
Lymphocytes	0.729	0.783	0.876
Platelets	0.310	0.23	0.076

Data expressed are r values. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure

hypertensive patients when compared with normotensive individuals. These abnormal platelet functions may cause damage to the organs.<sup>10</sup> It was reported that the PLR was significantly higher in hypertensive patients.<sup>10</sup> NLR had a more predictive power to diagnose hypertension-related events like atherosclerosis. The present study shows significant NLR and non-statically significant PLR. Hence, this present study concludes that inflammation also proceeds hypertension because inflammation releases the inflammatory cytokine chemoattractant, leucocyte requirement. These inflammatory changes produce increased vascular permeability, endothelial dysfunction, and vascular smooth muscle proliferation. All the consequences occur in hypertension patients. Hence, NLR can be introduced in the routine diagnosis of hypertension.

As inflammation is known to play an important role in diseases such as hypertension, diabetes mellitus, and renal diseases, the neutrophils which are first-line defenders play a key role in the process of inflammation. These neutrophils release the cytokines that will act on other blood cells. They increase the activity of platelets which leads to the formation of a thrombus.<sup>11-13</sup> A study reported an association between the increased PLR ratio with elevated ST segment in myocardial infarction patients.<sup>14</sup> Increased PLR and NLR ratio and increased levels of

C-reactive proteins were reported in the hypertensive patients.<sup>15</sup> Hence, the NLR and PLR ratio are the predictors for cardiovascular diseases.<sup>16</sup> Absolute neutrophil and lymphocyte count, and platelet count are easy to obtain through complete blood count analysis and their ratio shows predictors of chronic inflammation in hypertensive patients produce atherosclerotic plaque, thromboembolic disease, coronary heart disease, and ischemic condition. It is less expensive and cost-effective. Hence, this investigation can be applied to all patients.

#### Limitations of the study

The study sample size is less and single-center study. Hence, results cannot be generalized.

## CONCLUSION

The present study results support that the NLR and PLR can be used as markers for the diagnosis of cardiovascular diseases. These tests are cost-effective and accurate. Hence, this can be implemented in the diagnosis of cardiovascular diseases. The study recommends further studies involving multiple centers and increased sample size.

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**Authors' Contributions:**

**SS, BM-** Design of the study, review of literature, analysis, and preparing the manuscript; **MM, BM-** Data collection, preparing the manuscript; **SSKG, SS-** Analysis and preparing the manuscript.

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