

## RESEARCH

# Correlation of neutrophil–lymphocyte ratio with carotid intima–media thickness in diabetes-an analytical cross-sectional study

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**Background:** Atherosclerosis, the growth of fibrofatty lesions in the arterial wall, is a major cause of illness and mortality across the world. Cardiovascular disease, stroke, and coronary heart disease risk are increased in diabetics compared to nondiabetics. Carotid intima–media thickness (CIMT), performed by radiologists has been widely regarded as a marker of atherosclerosis. Neutrophil–lymphocyte ratio (NLR) is an easily available and reproducible test and is said to be a marker of inflammation. In this study, our aim was to assess the correlation of NLR with CIMT in diabetes patients.

**Methods:** A total of 25 Type 2 diabetic patients (F:M = 7:18, mean age:  $71.56 \pm 9.63$ ) were included. Complete blood count (CBC) was done and CIMT was measured. Depending on CIMT, the patients were divided into the following two groups: High CIMT group ( $>1$  mm) and normal CIMT group ( $<1$  mm).

**Results:** Mean NLR was found to be higher in diabetes patients with thick CIMT compared to those with normal CIMT. This was statistically significant ( $p < 0.05$ ). There was no difference in mean neutrophil count and mean lymphocyte count between the two groups.

**Conclusion:** In this study, mean NLR was found to be higher in diabetes patients with higher CIMT than normal CIMT. Hence, NLR can be used to predict atherosclerosis in diabetes patients. Being cheaper, it can be used to predict adverse atherosclerotic events such as cerebrovascular accidents and coronary syndromes in diabetes patients, and the progression of these events in the same.

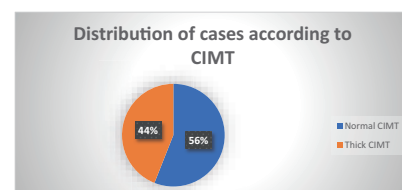
**Keywords:** diabetes, carotid intima–media thickness, neutrophil lymphocyte ratio, atherosclerosis

## Introduction

Atherosclerosis, defined as the growth of fibrofatty lesions in the arterial wall, is a major source of morbidity and death, accounting for the majority of myocardial infarctions and strokes, as well as debilitating peripheral artery disease. The immune system is thought to be involved, and new risk factors include inflammation and clonal hematopoiesis (1).

The carotid intima–media thickness test (CIMT) is a test used to determine the degree of atherosclerotic vascular disease in the carotid arteries. The test examines the thickness

of the carotid artery's inner two layers, the intima and the media, and warns doctors to any thickening while patients are still asymptomatic.



**FIGURE 1 |** Distribution of cases according to Carotid intima media thickness.

**TABLE 1** | Descriptive statistics.

Statistics	Age	TC	Neutrophil	Lymphocyte	NLR	CIMT
<i>N</i>	25	25	25	25	25	25
Mean	71.56	76.77	53.96	30.54	1.95	0.88
Median	71	76.8	41.39	29.9	1.2	0.95
Standard deviation	9.63	18.84	13.24	13.58	1.12	0.24
Minimum	44	41.60	17.99	9.32	0.6	0.5
Maximum	86	109	76.35	53.17	4.2	1.2
Percentiles 25	67	58.72	35.24	18.1	0.92	0.7
50	76	76.8	41.39	29.99	1.2	0.95
75	78	89.4	47.92	44.35	2.89	1.1

The neutrophil–lymphocyte ratio (NLR) is the ratio between the neutrophil and lymphocyte counts measured in blood. Neutrophils contribute to innate and lymphocytes to the adaptive immune response in the body. It is an emerging biomarker with applications in diseases such as cancer, sepsis, bacteremia, COVID-19 (2).

NLR is a widely available, easily derived, and reproducible marker of inflammation (3).

NLR has been shown to predict cardiovascular events in several studies (4).

Although C-reactive protein, interleukin-6, and tumor necrosis factor-alpha are known to predict carotid atherosclerosis, obtaining them in clinical practice is problematic.

Diabetes patients and those with prediabetes have a higher risk of death from CVD, coronary heart disease, and stroke compared to those who do not have diabetes (5).

Various studies have shown a correlation of CIMT with Cardiovascular disease (6).

This study aims to find a correlation between NLR with CIMT in diabetes patients.

## Objective

To study the association between NLR and CIMT in diabetes patients.

## Materials and methods

This is a hospital-based analytical cross-sectional study conducted in the Department of Internal Medicine, Sree Gokulam Medical College and Research Foundation, Trivandrum. It was conducted over a period of 2 weeks (1 August 2023–14 August 2023).

The patients were known cases of type-2 diabetes mellitus who were more than 18 years of age, who had blood investigations done, who underwent a carotid Doppler and who gave consent to participate in the study.

**TABLE 2** | Correlation between NLR, TC, age with carotid intima thickness.

Variable	<i>n</i>	CIMT	<i>p</i> -value
NLR	25	0.76	–0.01
TC	25	–0.130	0.5357
Age	25	0.186	0.3734

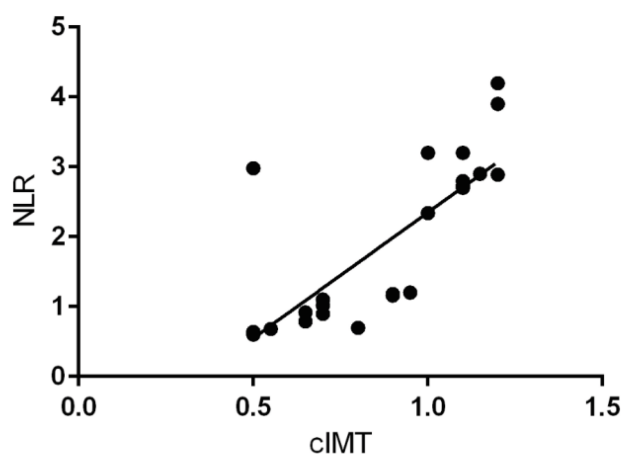
The following categories of patients were excluded: Acute stroke, myocardial infarction, any acute or chronic infection or inflammatory condition in the last 2 weeks, hematological disease, smokers, those with cancer, and taking steroids. A total of 25 patients who matched the inclusion and exclusion criteria were selected by consecutive random sampling from 1 August 2023 to 14 August 2023 after the institutional ethics committee's clearance was obtained. Informed written consent was taken from the participants and the study was started. The study was cross-sectional in design. The 25 adults included in the study were in the age group of 44–86 years and had undergone carotid Doppler as part of screening along with blood investigations [complete blood count (CBC)]. A questionnaire was used to get patient details such as current and past medical history, smoking history, and laboratory investigations. Patients underwent clinical examination. Carotid intima–media thickness was measured at the common carotid artery using B-mode ultrasound. Patients were divided into two groups, one with thick CIMT  $\geq 1$  mm and one with normal CIMT  $< 1$  mm; 11 patients had thick CIMT and 14 normal CIMT in this study **Figure 1**. CBC was done on an automatic hematology analyzer, from which NLR was obtained by dividing the absolute neutrophil count (ANC) and absolute lymphocyte count (ALC). The collected data were entered into SPSS statistical data package. Quantitative data were expressed as mean  $\pm$  SD and qualitative data were expressed as percentage.

**TABLE 3** | Comparison of demographic and hematological parameters with CIMT.

Variables	CIMT	n	Mean $\pm$ SD	95% CI for mean		F-value	p-value
				Lower	Upper		
Age	Thick	11	73.45 $\pm$ 7.178	69.21	77.69	2.4	0.17
	Normal	14	70.071 $\pm$ 11.12	64.25	75.90		
TC	Thick	11	70.24 $\pm$ 20.05	73.42	90.32	1.54	0.146
	Normal	14	81.76 $\pm$ 16.14	59.73	80.74		

**TABLE 4** | Comparison of hematological parameters with CIMT.

Variable	CIMT	N	Mean $\pm$ SD	Median (IQR)	95% CI for mean		F-value	P-value
					Lower	Upper		
Neutrophil	Thick	11	49.18 $\pm$ 14.82	50.38 (27.55–80.55)	42.02	58.4	2.84	0.082
	Normal	14	43.39 $\pm$ 8.8	37.85 (17.99–47.92)	38.78	48		
Lymphocyte	Thick	11	16.93 $\pm$ 3.93	17.70 (9.31–22.28)	14.62	19.24	3	0.064
	Normal	14	41.67 $\pm$ 7.14	42.43(28.07–53.17)	45.41	37.93		
NLR	Thick	11	3.15 $\pm$ 0.46	2.98 (2.7–4.2)	3.42	2.88		
	Normal	14	0.90 $\pm$ 0.22	0.85 (0.6–1.2)	0.78	1.02		

**FIGURE 2** | Correlation between NLR and CIMT.

## Discussion

In this study, 25 participants were enrolled, of which 7 were female and 18 were male (Table 1). The baseline characteristics are represented in Table 3. The participants were divided into two groups one with normal CIMT (<1 mm) and another with high CIMT ( $\geq$ 1 mm).

In this study, no statistically significant correlation between total leucocyte count and CIMT was found (Table 2). There was no statistically significant difference in mean neutrophil or mean lymphocyte count between the two groups (Table 4).

However, NLR was higher in patients with thick CIMT, which was statistically significant. In this study, a strong

correlation was noticed between NLR and CIMT in diabetes patients (Table 2).

This is similar to the result obtained in the study by Mohammad et al. (7), Gu et al. (8) which showed NLR has a strong association with CIMT in diabetes.

Many epidemiological studies have found that CIMT is a measure of subclinical atherosclerosis that is linked to traditional CVD risk factors (9–11).

Thus, high NLR correlates with high CIMT and risk of atherosclerotic events in type 2 diabetes.

## Conclusion

In this study mean NLR was higher in diabetes patients with higher CIMT compared to those with normal CIMT. This was found to be statistically significant. Hence, NLR can be used to predict atherosclerosis in diabetes patients.

Being cheaper, it can be used to predict adverse atherosclerotic events such as cerebrovascular accidents and coronary syndromes in diabetes and the progression of these events in the same.

## Author contributions

Both authors have made a substantial, direct, and intellectual contribution to this work and approved it for publication.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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