RESEARCH PAPER

Evaluation of NLR and PLR in T2DM with Coexisting Hypothyroidism and Their Correlation with TSH

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Abstract

Type 2 Diabetes Mellitus (T2DM) and hypothyroidism frequently coexist and contribute to a pro-inflammatory state, potentially complicating disease progression and management. This cross-sectional study aimed to evaluate the correlation between Neutrophil-to-Lymphocyte Ratio (NLR), Platelet-to-Lymphocyte Ratio (PLR), and Thyroid-Stimulating Hormone (TSH) levels in individuals with T2DM and hypothyroidism. A total of 200 participants were enrolled, including 100 cases and 100 age- and sex-matched controls. NLR and PLR were significantly elevated in the case group, with a strong positive correlation observed between TSH and NLR ($r = 0.558$, $p < 0.001$), and a moderate correlation with PLR ($r = 0.397$, $p < 0.001$). ROC analysis showed good diagnostic performance for NLR (AUC = 0.795), while PLR showed limited discriminatory ability (AUC = 0.601). These findings suggest that NLR may serve as a reliable, low-cost inflammatory marker in T2DM patients with hypothyroidism.

Keywords: Type 2 Diabetes Mellitus, Neutrophil-to-Lymphocyte Ratio, Hypothyroidism.

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Introduction

Type 2 diabetes mellitus (T2DM) and hypothyroidism are two prevalent endocrine disorders that frequently coexist, particularly in middle-aged and elderly populations. Both conditions independently contribute to systemic inflammation and metabolic dysregulation, thereby amplifying the risk of cardiovascular complications, insulin resistance, and poor glycemic control[1,2]. While the interplay between thyroid function and glucose metabolism has been extensively studied, the shared inflammatory pathways in patients with concurrent T2DM and hypothyroidism remain underexplored[3].

Recent interest has focused on simple, cost-effective hematological markers derived from routine complete blood counts, such as the neutrophil-to-lymphocyte ratio (NLR) and the platelet-to-lymphocyte ratio (PLR), as surrogate indicators of systemic inflammation[4]. Elevated NLR and PLR values have been associated with poor glycemic outcomes, increased insulin resistance, and subclinical inflammation in T2DM[5,6]. Similarly, hypothyroidism, particularly in its subclinical form, is known to modulate immune function and may influence these inflammatory indices[7,8].

Thyroid-stimulating hormone (TSH), the primary biomarker for hypothyroid status, may correlate with variations in NLR and PLR, reflecting the immuno-metabolic interdependence between thyroid dysfunction and diabetes[9]. However, limited data exist on how these inflammatory markers behave in individuals affected by both conditions simultaneously. This study aims to evaluate the levels of NLR and PLR in patients with T2DM and coexisting hypothyroidism and to analyze their correlation with TSH levels, thereby elucidating potential inflammatory linkages that could aid in risk stratification and disease monitoring.

Materials and Methods

This age- and sex-matched cross-sectional study was conducted in the Department of Biochemistry at Chettinad Academy of Research and Education over six months, following ethical clearance from the Institutional Human Ethics Committee (IHEC), CARE (Ref No: IHEC-I/2553/24 on 2024-03-04). The objective was to investigate the association between inflammatory markers—neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR)—and thyroid function in individuals with Type 2 Diabetes Mellitus (T2DM) and hypothyroidism. A total of 200 participants were recruited and divided into

two groups: 100 healthy controls and 100 individuals with confirmed diagnoses of T2DM and coexisting hypothyroidism, based on ADA and American Thyroid Association guidelines, respectively. The age range of participants was 35–70 years, and both sexes were included.

Inclusion criteria comprised individuals with established T2DM and hypothyroidism, while exclusion criteria included patients with hepatic, cardiovascular, renal, or traumatic conditions; those on medications influencing the study parameters; individuals with Type 1 diabetes, pregnancy, lactation, or other thyroid disorders. Demographic and clinical information was obtained through a structured questionnaire, and anthropometric measurements (height, weight, BMI, blood pressure) were recorded. Fasting venous blood (10 mL) was collected and processed to analyze fasting and postprandial glucose levels, lipid profile, and thyroid hormones (TSH, fT3, fT4) using the Unicell DxC 600 immunoanalyzer. Complete blood count (CBC) was performed to derive absolute neutrophil, lymphocyte, and platelet counts, from which NLR and PLR were calculated.

Statistical analysis

Data were analyzed using statistical software, SPSS. Data were expressed as mean ± standard deviation (SD). Comparisons between groups were performed using independent samples t-test. Correlations between NLR, PLR, and TSH levels were assessed using Pearson's correlation coefficient. A p-value < 0.05 was considered statistically significant.

Results and Discussion

The present study investigated the relationship between inflammatory markers, namely Neutrophil-to-Lymphocyte Ratio (NLR) and Platelet-to-Lymphocyte Ratio (PLR), and thyroid dysfunction in individuals with Type 2 Diabetes Mellitus (T2DM) coexisting with hypothyroidism. The analysis highlights significant metabolic and hematological differences between T2DM patients with hypothyroidism and healthy controls, emphasizing the systemic inflammatory milieu associated with dual endocrinopathies.

Table 1 findings demonstrated significantly elevated body weight, BMI, HbA1c, fasting and postprandial glucose levels, and TSH values in the case group compared to controls ($p < 0.001$). These results are consistent with previous literature which shows that hypothyroidism, through reduced basal metabolic rate and insulin resistance, exacerbates the metabolic derangements of T2DM[10]. The observed increase in adiposity and poor glycemic control in the case group underscores the clinical need for early screening and integrated management of thyroid dysfunction in diabetic patients.

Table 1: Descriptive Statistics

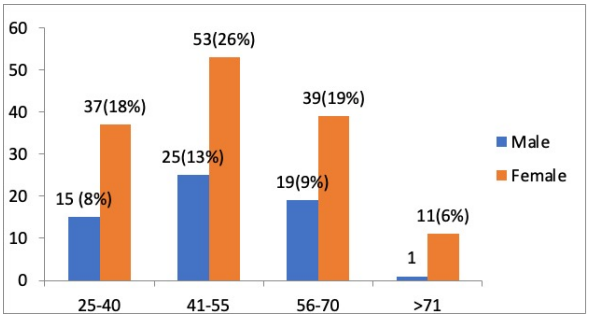
Parameter	Case (Mean ± SD)	Control (Mean ± SD)	P Value
Weight(kg)	65.70±11.50	51.04±7.8	0.000*
Height(cm)	1.4±10	1.4±10	1.000
BMI	25.0±2.9	23.10±2.20	0.000*
HbA1c(%)	7.7±1.3	5.1±.45	0.000*
TSH(µIU/L)	12.7±15.3	3.9±.89	0.000*
FBS(mg/dl)	149.4±50.7	84.8±13.9	0.000*
PPBS(mg/dl)	234.1±56.7	102.7±14.9	0.000*
Neutrophil(%)	84.7±10.8	62.8±13.7	0.007*
Lymphocyte(%)	32.5±7.4	33.9±11.7	0.208
Platelet(Lakhs/µl)	3.2±.86	2.9±.90	0.038*

P Value <0.05* is statistically significant

Additionally, significant elevations in neutrophil and platelet counts ($p = 0.007$ and $p = 0.038$, respectively) were noted in the case group, with no significant change in lymphocyte percentage. These alterations support the hypothesis of a pro-inflammatory state in T2DM complicated by hypothyroidism. Similar hematologic trends were reported by Ozdin et al.[11] and Chen et al. [9], who also noted raised NLR and PLR in diabetic populations.

Gender distribution showed female predominance (69%) among the affected population, aligning with epidemiological data that hypothyroidism is more common in females, especially in middle age [12]. Age-wise distribution (Figure 1) indicated that individuals between 41–55 years are most commonly affected, suggesting that mid-life hormonal and metabolic shifts may increase susceptibility to dual endocrinopathies.

Figure1:Age wise distribution among males and females in cases



Correlation analysis (Table 2) revealed a significant positive relationship between TSH and both NLR ($r = 0.558$, $p < 0.001$) and PLR ($r = 0.397$, $p < 0.001$), indicating that worsening thyroid dysfunction is moderately associated with elevated inflammatory markers. This supports the findings of Chen et al.[9], who found that higher TSH levels correlate with increased systemic inflammation, as reflected by elevated NLR and PLR values.

Table 2: Correlation analysis between NLR,PLR and TSH among cases

	Variables	R-Value	P -Value
Type 2 diabetes with hypothyroidism	NLR	.558	0.000
	PLR	.397	0.000

Table 3 further established that NLR was significantly elevated across all age groups among cases, with the highest values in the 25–40 age group ($p < 0.001$). This suggests a robust inflammatory response even in younger individuals with T2DM and hypothyroidism. These results are consistent with those of Iwakura et al. [13], who observed heightened NLR in younger diabetic patients with thyroid dysfunction.

Table 3: Age group-wise comparisons - NLR

	Case/Control		
Age	Mean ± SD	t value	P value
25-40	2.64±0.574	3.369	0.00*
41-51	2.09±0.64	3.72	0.00*
56-70	1.76±0.464	7.350	0.00*
>71	1.887±0.51	3.364	0.00*

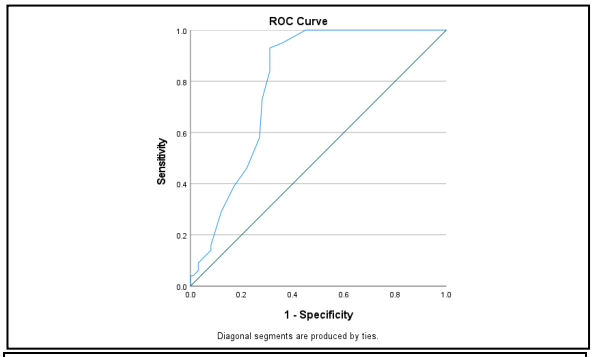
PLR (Table 4) showed a significant difference only in the 41–51 age group ($p = 0.018$), reflecting a more age-dependent pattern in platelet-mediated inflammation. Other age groups showed no significant changes, suggesting that PLR may be less consistent as a systemic marker across age ranges. This limited utility of PLR was similarly reported by Gasparyan et al. [14].

Table 4: Age group-wise comparisons –PLR

	Case/Control		
Age	Mean ± SD	t value	P value
25-40	1.796±0.66	0.86	1.753
41-51	1.875±0.7	0.986	0.018*
56-70	1.703±0.40	0.03	2.235
>71	1.52±0.33	0.112	1.781

The diagnostic accuracy of NLR and PLR was evaluated using ROC analysis. The area under the curve (AUC) for NLR was 0.795 ($p < 0.001$), indicating good diagnostic potential for identifying patients with T2DM and hypothyroidism. Conversely, PLR had a lower AUC of 0.601 ($p = 0.014$), signifying limited discriminatory power. Similar ROC performance of NLR has been reported by Jaaban et al. [15] in inflammatory endocrinopathies.

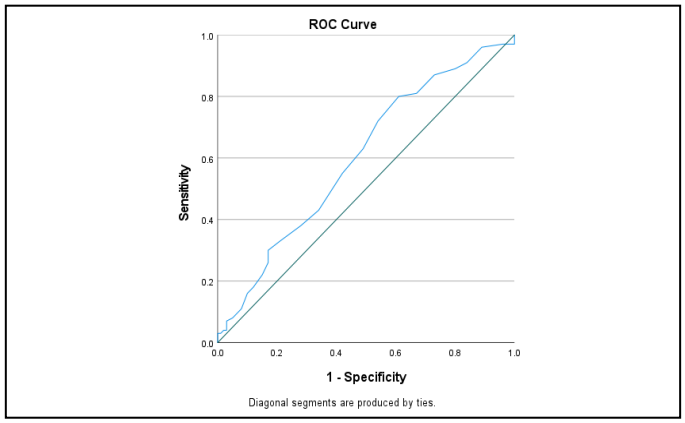
FIGURE2: ROC CURVE - NLR



Area Under the Curve

Area	Std. Error	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.795	.034	0.000	.729	.861

Figure3: ROC CURVE -PLR



Area Under the Curve

Area	Std. Error	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.601	.040	0.014	.523	.679

Taken together, the findings of this study highlight the relevance of NLR as a reliable, cost-effective marker of systemic inflammation in T2DM patients with hypothyroidism. PLR may have supplemental value in older age groups but lacks consistency across all ages. Routine assessment of NLR could aid in monitoring inflammatory burden and guiding therapeutic strategies in such patients.

Conclusion

This study highlights a significant association between thyroid dysfunction and systemic inflammation in individuals with Type 2 Diabetes Mellitus and hypothyroidism. Elevated NLR and PLR values, particularly the strong correlation of NLR with TSH and its diagnostic accuracy, underscore their potential as accessible inflammatory markers in this dual endocrine disorder. These findings suggest that NLR, more than PLR, may aid in early identification of inflammatory risk and facilitate better monitoring and management in T2DM patients with thyroid dysfunction. Further longitudinal studies are warranted to validate these markers in clinical risk stratification.

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Conflict of Interest

The authors declare no conflict of interest

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