ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 03 | March - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSESSMENT AND CORRELATION OF ALTERED LEUCOCYTE COUNT IN DIABETES AND PREDIABETES

Physiology

Dr. R. Gayathri Assistant Professor, Bhaarath Medical College and Hospital, BIHER, Tamilnadu, India.

Rubica.V Final year MBBS student, Bhaarath Medical College and Hospital, BIHER, Tamilnadu, India.

Dr. Arvind.T Associate Professor, Bhaarath Medical College and Hospital, BIHER, Tamilnadu, India.

ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder associated with persistent hyperglycemia and systemic inflammation. Alterations in leukocyte count have been suggested as potential inflammatory markers in diabetes and prediabetes. **Aim:** To assess and correlate altered leukocyte count with glycaemic status in patients with diabetes and prediabetes. **Materials And Methods:** This cross-sectional study included 174 subjects (87 diabetes and 87 prediabetes). HbA1c was measured using immunoturbidometric assay, and total leukocyte count (TLC) with differential counts were obtained using SYSMEX XN550 hematology analyzer. Statistical analysis was performed using SPSS version 20. Pearson correlation and independent sample t-test were applied. **Results:** The mean TLC in diabetes was 10,712.5 ± 3861.4 cells/µL and in prediabetes was 7,626.43 ± 1505.2 cells/µL. Mean HbA1c in diabetes and prediabetes was 7.84 ± 0.99% and 6.17 ± 0.94% respectively. A statistically significant association was observed between leukocyte count and glycaemic status in both groups ($p < 0.001$). However, Pearson correlation showed a negative but statistically non-significant correlation between HbA1c and total leukocyte count in diabetes. In prediabetes, neutrophil count showed a statistically significant negative correlation with HbA1c. **Conclusion:** Leukocyte count alterations are associated with glycaemic status in diabetes and prediabetes. Although overall correlation was weak, differential leukocyte parameters, particularly neutrophils in prediabetes, may serve as early inflammatory markers. Larger longitudinal studies are required to establish causality.

KEYWORDS

Diabetes mellitus

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to insulin deficiency, insulin resistance, or both [8]. The global prevalence of type 2 diabetes mellitus (T2DM) continues to increase and is associated with significant morbidity and mortality due to microvascular and macrovascular complications [15]. Inflammation plays a central role in the pathogenesis of diabetes and its complications. White blood cells (WBCs) are important mediators of inflammation and immune response. Alterations in leukocyte count may reflect underlying subclinical inflammation in diabetic individuals [1].

IL-6 and C-reactive protein (CRP) are commonly elevated inflammatory markers in diabetes, and several studies have reported associations between WBC count and insulin resistance or glycaemic status [6,15]. Elevated WBC count has been shown to predict incident T2DM independent of insulin resistance in non-obese adults [4].

Neutrophil dysfunction contributes to increased susceptibility to infections in diabetes mellitus [11]. Studies have demonstrated that reduction of circulating neutrophils may precede the onset of type 1 diabetes [10].

Prediabetes represents an intermediate metabolic state characterized by impaired fasting glucose or impaired glucose tolerance [7]. Early identification of inflammatory changes during this stage may help predict progression to overt diabetes.

Therefore, this study was undertaken to assess and correlate altered leukocyte count in diabetes and prediabetes.

MATERIALS AND METHODS

Study Design

Cross-sectional analytical study.

Study Population

The study included 174 subjects (87 diabetes and 87 prediabetes) of both genders across different age groups.

Sample Size

Sample size was calculated based on previous studies assuming 80% power and 5% level of significance. The minimum required sample size was 174 (87 per group).

Inclusion Criteria

- Diagnosed Type 1 or Type 2 diabetes (≥5 years duration, on regular treatment)
- Prediabetes

Exclusion Criteria

- Severe illness
- Pregnancy
- Smokers and alcoholics
- Patients on antihypertensive or anticoagulant therapy
- Malignancy
- Recent infection (within past two weeks)
- Chronic inflammatory diseases

Data Collection

Demographic details including age, gender, BMI, duration of diabetes, and family history were recorded.

Laboratory Methods

- HbA1c was estimated using immunoturbidometric assay (auto-calibrated system).
- Complete blood count was analyzed using SYSMEX XN550 automated hematology analyzer.
- Total leukocyte count and differential counts were recorded.

Statistical Analysis

Data were analyzed using Microsoft Excel and SPSS version 20. Independent sample t-test was used to compare means. Pearson correlation was used to assess association between HbA1c and leukocyte parameters. A p-value <0.05 was considered statistically significant.

RESULTS

Among 174 participants, females constituted more than 50% of the sample. Majority (70–80%) were aged between 40–50 years. No significant gender disparity was observed.

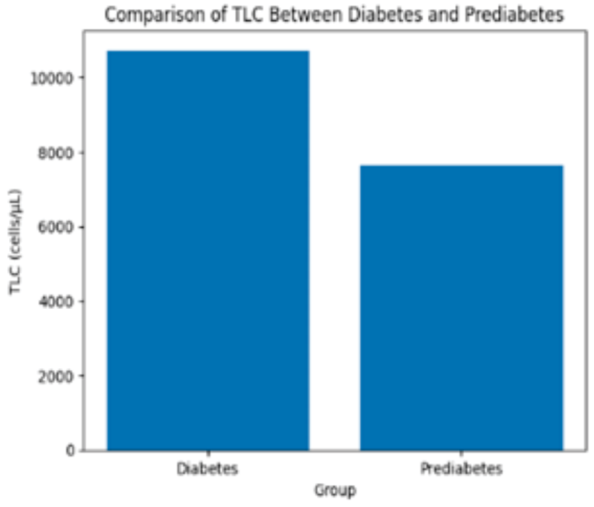
Leukocyte parameters were significantly higher in diabetes compared to prediabetes ($p < 0.001$).

Pearson correlation analysis in diabetes showed weak negative correlations between HbA1c and total leukocyte count ($r = -0.0586$, $p = 0.5898$), neutrophils, lymphocytes, and eosinophils; however, these were not statistically significant.

In prediabetes, neutrophil count showed a statistically significant negative correlation with HbA1c, whereas total leukocyte count, lymphocytes, and eosinophils did not show significant correlation.

Comparison Between Groups

Parameter	Diabetes (Mean ± SD)	Prediabetes (Mean ± SD)	P-value
TLC (cells/μL)	10,712.5 ± 3861.4	7,626.43 ± 1505.2	<0.001
Neutrophils (%)	84.29 ± 28.48	67.40 ± 12.72	<0.001
Lymphocytes (%)	30.39 ± 10.49	31.26 ± 12.71	<0.001
Eosinophils (%)	2.50 ± 1.70	2.28 ± 1.57	<0.001
HbA1c (%)	7.84 ± 0.99	6.17 ± 0.94	<0.001



Correlation Analysis

In diabetes:

- Negative correlation between HbA1c and TLC (r = -0.0586, p = 0.5898)
- Negative correlation between HbA1c and neutrophils, lymphocytes, eosinophils (not statistically significant)

In prediabetes:

- Negative correlation between HbA1c and neutrophils (statistically significant)
- No significant correlation with TLC, lymphocytes, or eosinophils.

DISCUSSION

The present study was conducted to evaluate the role of leukocytes in patients with diabetes and prediabetes and to determine their correlation with glycaemic control as assessed by HbA1c levels. Prediabetes represents an intermediate metabolic state characterized by impaired glucose regulation. According to established diagnostic criteria, impaired fasting glucose is defined as fasting plasma glucose levels between 100–125 mg/dL, and impaired glucose tolerance is defined as 2-hour plasma glucose levels between 140–199 mg/dL following an oral glucose tolerance test [7,8]. Identification of inflammatory alterations during this stage may help in early risk stratification.

Leukocytes play a significant role in immune defense, and their dysfunction contributes to increased susceptibility to infections in diabetic individuals. Hilson reported that neutrophils and platelets play an important role in the prognosis of diabetic patients [1]. Impairment in neutrophil functions such as chemotaxis, phagocytosis, and microbicidal activity has been documented in diabetes, leading to compromised host defense mechanisms [1,11]. Techniques such as isotopic labeling and scanning of white blood cells have also been utilized to detect occult infections in diabetic patients [1].

Our study aimed to examine the relationship between leukocyte count and HbA1c levels in patients with established diabetes of at least five years duration, as well as in individuals with prediabetes. We observed significant differences in leukocyte parameters between groups, suggesting the presence of inflammatory changes even in early stages of dysglycemia.

Xu et al. demonstrated that both total leukocyte and neutrophil counts were elevated, while eosinophil counts were reduced in patients with diabetic ketoacidosis [2]. The authors suggested that metabolic acidosis and elevated ketone bodies may increase leukocyte production and release, while oxidative stress and accelerated apoptosis may reduce monocyte and eosinophil counts.

Similarly, Biadgo et al. reported significantly higher total WBC count (6.59 ± 1.42 vs $5.56 \pm 1.38 \times 10^3/\mu L$), absolute lymphocyte count (2.60 ± 0.70 vs $2.04 \pm 0.63 \times 10^3/\mu L$), and absolute neutrophil count (3.57 ± 1.46 vs $3.11 \pm 1.04 \times 10^3/\mu L$) in diabetic patients compared to controls [3]. These hematological alterations were considered potential indicators of vascular complications and glycaemic control in type 2 diabetes mellitus.

Park et al., in a longitudinal 10-year study among non-obese Korean adults, demonstrated that higher WBC count was positively and independently associated with incident T2DM [4]. This association remained significant even after adjusting for insulin resistance, suggesting that inflammatory mechanisms beyond insulin resistance—such as pancreatic β-cell dysfunction and gut microbiota alterations—may contribute to disease progression.

A case-control study from the Tabari cohort also reported a significantly higher mean WBC count in diabetic patients compared to controls (6.89 ± 1.67 vs $6.37 \pm 1.49 \times 10^3/\mu L$; $P \leq 0.001$), supporting the association between leukocyte count and diabetes mellitus [5].

Jiang et al. further reported that elevated circulating WBC counts were associated with worsening glucose metabolism and higher risk of impaired glucose regulation and T2DM in middle-aged and elderly populations [9]. WBC count was also associated with anthropometric and metabolic parameters such as BMI, waist-hip ratio, triglycerides, HDL levels, HbA1c, and postprandial glucose levels. These findings suggest that control of metabolic risk factors may help reduce chronic subclinical inflammation.

Moradi et al. demonstrated that higher leukocyte counts were significantly correlated with both microvascular and macrovascular complications in diabetic patients [13]. Retinopathy and cardiac events were three times more prevalent in individuals with higher leukocyte counts, and nephropathy was more than twice as common. These findings emphasize the potential utility of leukocyte count as a simple, cost-effective marker for predicting diabetic complications.

Although our study demonstrated statistically significant differences in leukocyte counts between diabetes and prediabetes groups, the correlation between HbA1c and total leukocyte count was weak. However, neutrophil count in prediabetes showed a significant negative correlation with HbA1c, suggesting early inflammatory involvement before the development of overt diabetes. The discrepancy between significant group differences and weak correlation may be due to the cross-sectional design and limited sample size.

Overall, the findings support the concept that leukocyte alterations reflect underlying inflammatory processes in dysglycemic states and may have potential clinical utility in early detection and monitoring.

CONCLUSION

Leukocyte count alterations are associated with glycaemic status in diabetes and prediabetes. Differential leukocyte parameters, particularly neutrophils in prediabetes, may serve as early inflammatory markers. Larger longitudinal studies are recommended to confirm their predictive value.

REFERENCES

1. Hilson R. Diabetes and the blood – white cells and platelets. Pract Diabetes. 2015;32(5):159–160.
2. Xu W, Wu HF, Ma SG, Bai F, Hu W, Jin Y, et al. Correlation between peripheral white blood cell counts and hyperglycaemic emergencies. Int J Med Sci. 2013;10:758–765.
3. Biadgo B, Melku M, Abebe SM. Hematological indices and their correlation with fasting blood glucose level and anthropometric measurements in type 2 diabetes mellitus patients in Gondar, Northwest Ethiopia. Diabetes Metab Syndr Obes. 2016;9:91–99.
4. Park JM, Lee HS, Park JY. White blood cell count as a predictor of incident type 2 diabetes mellitus among non-obese adults: a longitudinal 10-year analysis of the Korean Genome and Epidemiology Study. J Inflamm Res. 2021;14:1235–1242.
5. Kheradmand M, Ranjbaran H, Alizadeh-Navaei R, Yakhkeshi R, et al. Association between white blood cell count and diabetes mellitus in Tabari cohort study: a case-control study. Int J Prev Med. 2021;12:121.
6. Hong JW, Noh JH, Kim DJ. Association between white blood cell counts within normal range and hemoglobin A1c in a Korean population. Endocrinol Metab (Seoul). 2018;33:79–87.
7. Gillett MJ. International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes. Clin Biochem Rev. 2009;30:197–200.
8. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014;37(Suppl 1):S81–S90.
9. Jiang H, Yan WH, Li CJ, Wang AP, Dou JT, Mu YM. Elevated white blood cell count is associated with higher risk of glucose metabolism disorders in middle-aged and elderly Chinese people. Int J Environ Res Public Health. 2014;11:5497–5509.

10. Valle A, Giamporcaro GM, Scavini M, Stabilini A, Grogan P, Bianconi E, et al. Reduction of circulating neutrophils precedes and accompanies type 1 diabetes. Diabetes. 2013;62:2072–2077.
11. Muller LMAJ, Gorter KJ, Hak E, Goudzwaard WL, Schellevis FG, Hoepelman AIM, et al. Increased risk of common infections in patients with type 1 and type 2 diabetes mellitus. Clin Infect Dis. 2005;41:281–288.
12. Smiley D, Chandra P, Umpierrez GE. Update on diagnosis, pathogenesis and management of ketosis-prone type 2 diabetes mellitus. Diabetes Manag (Lond). 2011;1:589–600.
13. Moradi S, Kerman SR, Rohani F, Salari F. Association between diabetes complications and leukocyte counts in Iranian patients. J Inflamm Res. 2012;5:7–11.
14. Rizvi A, Sanders MB. Assessment and monitoring of glycemic control in primary diabetes care: monitoring techniques, record keeping, tests of average glycaemia, and point-of-care evaluation. J Am Acad Nurse Pract. 2006;18:11–21.
15. Lontchi-Yimagou E, Sobngwi E, Matsha TE, Kengne AP. Diabetes mellitus and inflammation. Curr Diabetes Rep. 2013;13:435–444.