DOI: 10.7860/JCDR/2024/68347.19405

Original Article

Internal Medicine Section

Correlation between Neutrophil to Lymphocyte Ratio and Urine Albumin to Creatinine Ratio in Diabetic Nephropathy Patients: A Cross-sectional Study

BM RAKESH[1], N PRADEEP[2], GJ NISCHAL[3]

ABSTRACT

Introduction: One of the microvascular complications of diabetes is known as Diabetic Nephropathy (DN). The clinical manifestation of DN is an increase in the amount of albumin excreted in the urine. Albuminuria is the inflammatory process that occurs before end-stage renal failure and is a diagnostic marker. The total White Blood Cell (WBC) count is a crude but sensitive measure of inflammation. It is examined as an inflammatory marker in various cardiac and non cardiac disorders, such as acute Myocardial Infarction (MI), stroke, and heart failure.

Aim: To find a correlation between Neutrophil to Lymphocyte Ratio (NLR) and Urine Albumin to Creatinine Ratio (UACR) in DN patients.

Materials and Methods: This was an analytical cross-sectional study done over a period of 18 months from January 2018 to June 2019 at Vydehi Institute of Medical Sciences and Research Centre in Bengaluru, Karnataka, India. on 104 subjects diagnosed with type 2 Diabetes Mellitus (DM) registered in present study. Spot albuminuria was tested by immune turbidimetry method. Urine creatinine was tested using Jaffe's kinetic method, from which spot UACR was calculated. The patients with albuminuria and without albuminuria were grouped into cases and controls, respectively. NLR was calculated using complete blood count and correlated with UACR. The estimated Glomerulus Filtration Rate (eGFR) was calculated using the Modification of Diet in Renal Disease (MDRD) equation and correlated with UACR. Cases were further subgrouped into moderately increased albuminuria and severely increased albuminuria groups. Mean and standard deviation, independent sample t-test, Chi-square test, Odds Ratio (OR) were applied to find significance. A p-value of <0.05 was considered statistically significant, and an OR more than one suggests a positive association.

Results: A total of 104 diabetic subjects were registered, with 52 subjects having DN and 52 having normal urine albumin. The mean age was 56±11.3 years and 50.6±11.8 years in the case and control groups, respectively. Among the 52 subjects in the case group, 12 (23.1%) were female and 40 (76.9%) were male. In the 52 control group, 30.8% (n=16) were female, and 69.2% (n=36) were male. The mean urine albumin was 75.5±121.2 mg/dL and 1.2±1.2 mg/dL in the case and control groups, respectively (p<0.001). A correlation was calculated between UACR and NLR, with a cut-off value for NLR of 2.92. The cut-off value for NLR was calculated using the Receivers Operating Curve (ROC). The Chi-square test was applied, showing statistical significance (p<0.001), with an OR calculated at 4.34 (OR >1).

Conclusion: The present study showed a significant positive correlation between NLR and UACR. Therefore, NLR may be considered a novel surrogate marker of DN, as an alternative to UACR, which is expensive and requires special equipment.

Keywords: Albuminuria, Biomarkers, Cytokines, Inflammation, Neutrophil to lymphocyte ratio

INTRODUCTION

Diabetes Mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Reduced insulin secretion, decreased glucose utilisation, and increased glucose production are factors that lead to hyperglycemia [1]. Type 2 DM is the predominant form of diabetes worldwide, accounting for 90% of cases globally. Numerous organ systems are affected by complications related to diabetes, which has led to the majority of morbidity and mortality [2]. One of the chief injuries arising from hyperglycemia is injury to the vasculature, which is classified as either small vascular injury (microvascular disease) or injury to the large blood vessels of the body (macrovascular disease) [3]. Macrovascular complications of diabetes, including coronary artery disease, stroke, and peripheral vascular disease, and microvascular complications such as end-stage renal disease (nephropathy), retinopathy, neuropathy, along with lower-extremity amputations, are responsible for much of the burden associated with diabetes [4].

The most common cause of Chronic Kidney Disease (CKD), including the need for renal replacement treatment, is DN [1]. The crude prevalence of CKD among adults with diabetes was over three times as high as that among adults without diabetes [5]. DN remains a major cause of morbidity and death for persons with either type 1 DM or type 2 DM [2]. Dialysis patients with diabetes have a poor prognosis, with survival rates equivalent to many forms of cancers [1].

According to the American Diabetes Association, urinary albumin should be assessed atleast once a year in patients with type 1 diabetes with a duration of five years and in all patients with type 2 diabetes [6]. Normal UACR is generally defined as <30 mg/g creatinine, and increased urinary albumin excretion is defined as >30 mg/g Cr [6]. In patients with type 2 DM, microalbuminuria is associated with a two-to-four-fold increase in the risk of death. In patients with overt proteinuria and hypertension, the risk is even higher [2]. Albuminuria in individuals with DM is associated with an increased risk of cardiovascular disease [1]. Albuminuria should be identified as part of comprehensive diabetes care at an early stage so that efficient treatments may be implemented.

The White Blood Cell (WBC) count is a simple, affordable, and sensitive indication of inflammation that may be performed routinely in the lab. Inflammation is positively correlated with WBCs [7]. Total

WBC is an independent marker of death/MI in patients who have or are at high-risk of Coronary Artery Disease (CAD); however, a high neutrophil count or low lymphocytes are more predictive [8].

Microalbuminuria is one of the first clinically observed abnormalities in diabetic nephropathy that develops into proteinuria as the disease progresses. The level of proteinuria is closely related to the progression of glomerulosclerosis and tubulointerstitial fibrosis. Podocytopathy is a common disorder in diabetic nephropathy that plays a role in the induction of glomerulosclerosis and the acceleration of plasma protein leakage through the glomerular basement membrane to Bowman's space. Proteinuria leads to further downstream damage of tubular cells, which can lead to the development of tubulointerstitial fibrosis and tubular atrophy [9].

It is now widely accepted that inflammation plays a major role in the development of atherogenic alterations and microvascular disorders [10]. Blood monocytes and tissue macrophages are key members of the mononuclear phagocyte system, a component of innate immunity. Recently, intensive research has shown that the influx of macrophages is a prominent feature during the progression of CKD [11]. Numerous inflammatory mediators, including adhesion molecules such as Vascular Cell Adhesion Molecule 1 (VCAM-1) and Intercellular Adhesion Molecule 1 (ICAM-1), Interleukins (IL-1, IL-6), Transforming Growth Factor beta-1 (TGF-1), and Tumour Necrosis Factor-alpha (TNF-alpha), as well as other cytokines, have been linked to DN [12]. However, because it is neither practical nor cost-effective, their measurement is not commonly employed. Moreover, remote and smaller medical facilities lack the necessary equipment to measure microalbuminuria. A new, easy-to-use, cost-effective marker of DN is required. NLR, which is applicable in these situations, is useful in this regard. As many diabetic patients present to hospitals with microvascular complications like nephropathy, simple tests like NLR help us to identify the complications (nephropathy) early, effectively manage diabetes, and prevent further progression of complications. Not much importance is given to NLR in diabetes patients in clinical practice. So present study was conducted to know whether NLR can be used as a marker for DN. The present study aimed to find a correlation between NLR and UACR in DN patients.

MATERIALS AND METHODS

This was an analytical cross-sectional study done over a period of 18 months from January 2018 to June 2019 at Vydehi Institute of Medical Sciences and Research Centre in Bengaluru, Karnataka, India. Patients diagnosed with type 2 DM with albuminuria that satisfied the inclusion criteria were included in the study. The study also included an equal number of patients with type 2 DM without albuminuria. Institutional Ethical Committee approval was obtained for the study (ECR/747/Inst/KA/2015), and informed written consent was obtained from all study subjects.

Sample size calculation: The sample size was calculated using the following formula: $n=\{2\times SD^2\times(Z\alpha+Z\beta)^2\}/d^2$, where Zβ is the Z value for the β error, SD is the Standard Deviation, d is'clinically meaningful difference'. The mean and standard deviation of NLR in the normal group are 1.94±0.65 [13], and in the DN group, it is 2.83±0.85 [13], with a pooled SD of 0.75. The mean difference (d) is 0.89. Assuming the alpha error is 5% and 80% power, Zα=1.96, Zβ=0.84. Therefore, the minimum required sample size is 15 in each group, but authors studied 52 patients in each group during the study period.

Inclusion criteria:

- Cases: Patients with type 2 DM (diagnosed according to ADA criteria) with albuminuria (UACR > 30 mg/g).
- Controls: Patients with type 2 DM without albuminuria.

Exclusion criteria:

- Patients with systemic hypertension;
- Patients with chronic infection and active systemic infections;
- Patients with Urinary Tract Infections (UTI)/fever;
- Smokers;
- Patients with autoimmune diseases;
- Patients on immunosuppressive drugs;
- Poor glycemic control {(Glycated Haemoglobin (HbA1c >10%)}.

Study Procedure

All patients diagnosed with type 2 DM after satisfying the inclusion and exclusion criteria underwent testing for spot UACR. The patients with albuminuria (>30 mg/g creatinine) and without albuminuria (<30 mg/g creatinine) [6] were grouped into cases and controls, respectively. NLR was calculated using a complete blood count and correlated with UACR. M-TP reagent was used to measure protein concentration in the urine by a timed end-point method and spot albuminuria by the immunoturbidimetric method [14]. The UACR was calculated from the values obtained by the above-mentioned methods. The NLR cut-off value was estimated by the ROC curve, and the correlation between NLR and UACR was calculated by a Chi-square test and OR. The estimated Glomerulus Filtration Rate (eGFR) was calculated by the Modification of Diet in Renal Disease (MDRD) equation and correlated with UACR [1]. The eGFR cut-off was estimated by the ROC curve, and the correlation between eGFR and UACR was calculated by a Chi-square test and OR. Cases were further subgrouped into moderately increased albuminuria (30-300 mg/g creatinine) and severely increased albuminuria (>300 mg/g creatinine) [15].

STATISTICAL ANALYSIS

The data was entered in an MS Excel file, analysed using Statistical Packages for Social Sciences (SPSS) software version 21.0 All descriptive statistics were represented with percentages. Mean with SD, Chi-square test, and OR were applied to find significance. $p<0.05$ was considered statistically significant. An OR more than 1 suggests a positive association.

RESULTS

A total of 104 patients with type 2 DM were divided equally into case and control groups. The mean age was approximately the same in both groups. Among the 52 subjects in the case group, 12 (23.1%) were female, and 40 (76.9%) were male. In the 52 control group, 16 (30.8%) were female, and 69.2% (n=36) were male. The blood investigations and laboratory parameters are summarised in [Table/Fig-1]. The mean Total Leukocyte Count (TLC) in both the case and control groups was almost the same. The mean NLR for case subjects was 3.4, and for control subjects, it was 2.5 (p=0.001).

Variables	Mean±SD		p-value
	Case (n=52)	Control (n=52)	
Age (in years) (Mean±SD)	56.0±11.3	50.6±11.8	0.018
Gender (N)			
Male	40	36	0.51
Female	12	16	
Duration of type 2 DM	7.4±6.9 years	5±4.5 years	0.042
Blood and laboratory parameters			
Total Leukocyte Count (TLC)	8609.6±2046.0 /µL	8700±2153.1/µL	0.827
Mean NLR	3.4±1.38	2.54±1.08	0.001
Mean urea	40.78±25.8 mg/dL	25.85±8.61 mg/dL	<0.001
Mean creatinine	1.47±1.03 mg/dL	0.84±0.29 mg/dL	<0.001
Mean urine albumin	75.5±121.2 mg/dL	1.2±1.2 mg/dL	<0.001
Mean UACR	1274.4±2065.3 mg/g	12.4±7.8 mg/g	<0.001
Mean eGFR value	70 mL/min/1.73 m^2	103.5 mL/min/1.73 m^2	<0.001

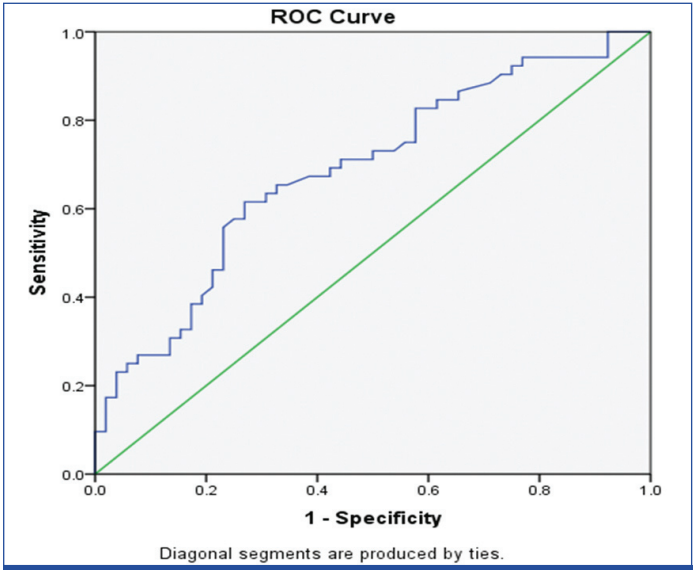
[Table/Fig-1]: Baseline characteristics, blood and laboratory parameters.

The mean urea and creatinine values in the case group were slightly higher than those in the control group, with a significant p-value of <0.001. The mean NLR and UACR were higher among cases compared to the control group with a significant p-value.

Correlation was calculated between UACR and NLR, with a cut-off value for NLR set at 2.92. The Chi-square test was applied, showing statistical significance (p<0.001), and an OR of 4.34 was calculated. An OR greater than 1 suggests a positive association (higher odds in the first category) [Table/Fig-2]. The cut-off value for NLR was 2.92, calculated by ROC curve. The sensitivity and specificity of NLR in present study were 61.5% and 73.1%, respectively, with a cut-off NLR of >2.92 [Table/Fig-3].

UACR (in mg/g creatinine)	NLR		p-value	OR
	Abnormal (>2.92)	Normal (<2.92)		
>30	32(61.5)	20 (38.5)	<0.001*	4.34
<30	14 (26.9)	38 (73.1)		

[Table/Fig-2]: Association between UACR and NLR.



[Table/Fig-3]: ROC curve for NLR.

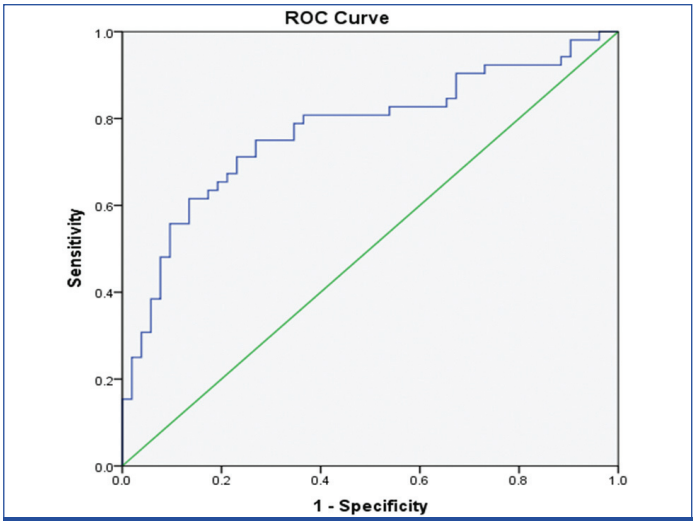
An association between UACR and eGFR was performed; the Chi-square test was applied with a cut-off value for eGFR set at 90.2. The p-value calculated was less than 0.001, which was statistically significant. The OR calculated was 8.14. An OR greater than 1 suggests an association between UACR and eGFR, as proteinuria increases, eGFR decreases [Table/Fig-4]. The cut-off value for eGFR was 90.2 mL/min/1.73 m^2, calculated by the ROC curve. The sensitivity and specificity of eGFR in present study were 75% and 73.1%, respectively, with a cut-off eGFR of <90.2 mL/min/1.73 m^2 [Table/Fig-5].

UACR	eGFR n (%)		p-value	OR
	(<90.2)	(>90.2)		
>30	39 (75)	13 (25)	<0.001*	8.14
<30	14 (26.9)	38 (73.1)		

[Table/Fig-4]: Association between UACR and eGFR (mL/min/1.73 m^2).

The case group, diabetes patients with albuminuria, were further subgrouped into moderately increased albuminuria and severely increased albuminuria based on the level of albuminuria. Moderately increased albuminuria is 30 to 300 mg/g creatinine, and severely increased albuminuria is >300 mg/g creatinine [Table/Fig-6] [15].

Based on the degree of albuminuria, subjects can be divided into three groups: diabetes with normal albuminuria UACR <30 mg/g cr, diabetes with moderately increased albuminuria 30 to 300 mg/g cr, and diabetes with severely increased albuminuria >300 mg/g cr [15]. The mean eGFR and NLR were correlated in these groups.



[Table/Fig-5]: ROC curve for eGFR.

Parameters	Case (52)	
	Count	%
Severely increased albuminuria (>300 mg/g creatinine)	27	51.9%
Moderately increased albuminuria (30-300 mg/g creatinine)	25	48.1%
Total	52	100.0%

[Table/Fig-6]: Cases (albuminuria patients) were subgrouped into moderately increased and severely increased albuminuria.

This shows that in diabetes patients, as the degree of proteinuria increases, eGFR decreases [Table/Fig-7].

The mean NLR was 2.54±1.08 in subjects with normal albuminuria, 3.27±1.49 in subjects with moderately increased albuminuria, and 3.53±1.28 in subjects with severely increased albuminuria. As the albuminuria increases, NLR increases significantly (p=0.002) [Table/Fig-8].

Variables	UACR in mg/g cr	eGFR in mL/min/1.73 m^2 (Mean±SD)
Control group: Diabetes without albuminuria	0-30 (normal)	103.52±29.22
Case group: Diabetes with moderately increased albuminuria	30-300	91.59±32.32
Case group: Diabetes with severely increased albuminuria	>300	49.93±27.75

[Table/Fig-7]: Association between mean eGFR and UACR (p<0.001).

UACR in mg/g creatinine	NLR
	Mean±SD
0-30	2.54±1.08
30-300	3.27±1.49
>300	3.53±1.28

[Table/Fig-8]: Comparison between mean NLR and UACR.

DISCUSSION

Due to its numerous potential complications, such as microvascular (DN, neuropathy, and retinopathy), and macrovascular (atherosclerosis, ischemic heart disease, stroke, and peripheral vascular disease, which frequently result in amputation), type 2 DM can have serious socioeconomic effects [1]. Approximately 25-40% of diabetic patients experience significant complications due to DN, which is also the main cause of end-stage renal failure [2].

In present study, the mean age was 56±11.3 years in the diabetes with albuminuria group and 50.6±11.8 years in the group without albuminuria, which was similar to the study conducted by Khandare S et al., [13]. A study by Kothai G et al., showed that most patients were in the age group of 51 to 60 years [16]. Males outnumbered females in both groups with and without nephropathy; while in

the study by Khandare S et al., females were slightly more than males; though Gupta N et al., showed that males outnumbered females [13,17].

The mean duration of type 2 DM was 7.4±6.9 years in the case group and 5±4.5 years in the control group. In the present study, the mean duration of diabetes in the study participants was 7.9±5.1 years and 8.4±5 years in studies by Kothai G et al., and Gupta N et al., respectively [16,17].

In the current study, the mean creatinine values in the normal and albuminuria groups were 0.84±0.29 mg/dL and 1.47±1.03 mg/dL, respectively, with a significant p-value of <0.001. Similarly, Gupta N et al., and Akbas EM et al., showed a significant increase in creatinine values as albuminuria increases [17,18]. In present study, eGFR (in mL/min/1.73m^2) was 69.96±36.41 in the case group and 103±29.22 in the control group. In a similar study by Khandare S et al., eGFR in the case and control groups was 85.71±27.72 and 96.2±28.23, respectively [13].

In present study, the mean urine albumin was 75.5±121.2 mg/dL in the case group and 1.2±1.2 mg/dL in the control group, respectively (p <0.001). The mean UACR in the case group (albuminuria group) was 1274.4±2065.3 mg/g and in the control group was 12.4±7.8 mg/g with a significant p-value of <0.001. Akbas E et al., showed that the UACR (median) in the normal group was 9.79 mg/g and in macroalbuminuria patients was 716 mg/g [18].

In present study, authors found that the mean NLR levels increased parallel to the albuminuria in diabetes patients. There was a statistically significant association between the NLR ratio and urine albumin creatinine ratio in diabetic patients, with a p-value of <0.001. The mean NLR of the case and control groups was 3.4±1.38 and 2.54±1.08, respectively. Khandare S et al., similar to the present study, found that NLR values were significantly higher in diabetic patients with nephropathy (2.83±0.85) than in diabetic patients without nephropathy (1.94±0.65) [13]. Another study done in diabetic patients by Gurmu MZ et al., also showed that NLR values were higher in the nephropathy group (2.66±0.49) compared to those without nephropathy (1.65±0.20) [19]. Moursy E et al., in a study to evaluate the relationship between NLR ratio and diabetic microvascular complications, showed that NLR was significantly higher in diabetic patients with complications (2.39±1.01) compared to patients without complications (1.41±0.30) [20]. The sensitivity and specificity of NLR in present study were 61.5% and 73.1%, respectively, with a cut-off NLR of >2.92. Tutan D and Dogan M found that the optimal value of NLR in diabetic patients for proteinuria discrimination was 1.93 with 57.4% sensitivity and 68.5% specificity [21]. Kothai G et al., showed that at an NLR cut-off of seven to predict DN, the sensitivity was 88.88% and specificity was 94.92% [16].

In the present study, we found that NLR was increasing as the degree of albuminuria increased. The mean NLR was 2.54 in subjects with normal albuminuria, 3.27 in subjects with moderately increased albuminuria (microalbuminuria) (30 to 300 mg/g), and 3.53 in subjects with severely increased albuminuria (macroalbuminuria). Kahraman C et al., also showed that the mean NLR was higher among macroalbuminuria group (3.6±1.3) compared to the microalbuminuria group (2.6±1.0) and the normal group (1.9±0.9) [22]. Unal A et al., showed that the median NLR ratio was 1.83, 2.23, and 2.77 in the normoalbuminuria, moderately increased albuminuria, and severely increased albuminuria groups [23].

The present study revealed that NLR was significantly increased in diabetes patients with albuminuria compared to those without albuminuria. Therefore, NLR could be considered as a predictor and a marker for diabetes with nephropathy.

Limitation(s)

The present study was a cross-sectional study. Further research with a prospective design and multiple NLR measurements will shed more light on the role of NLR as a marker of inflammation and a probable risk factor for DN. Future research should investigate other potential markers for proteinuria estimation in diabetic patients.

CONCLUSION(S)

The present study has shown a significant positive correlation between NLR and DN. NLR was significantly and independently elevated in parallel with albuminuria levels in diabetic patients. Therefore, NLR could be considered a potential predictor of nephropathy changes in diabetic patients. NLR is simple and easy to calculate, inexpensive, and can be routinely performed in settings with limited laboratory facilities, such as remote and smaller healthcare centres, making it an important marker for DN patients.

REFERENCES

[1] Harrison T, Kasper D, Fauci A, et al. Harrison's Principles of Internal Medicine. 20th edition New York: McGraw Hill Education; 2018.
[2] Brownlee M, Aiello LP, Cooper ME, Vinik AI, Plutzky J. Complications of Diabetes Mellitus, In: Melmed S, Polonsky KS, Larsen PR, Kronenberg HM. Williams Textbook of Endocrinology. 13th edition by Elsevier, Inc. 2016;1516-25.
[3] Fowler MJ. Microvascular and macrovascular complications of diabetes. Clinical Diabetes. 2011;29(3):116-22.
[4] Harding JL, Pavkov ME, Magliano DJ, Shaw JE, Gregg EW. Global trends in diabetes complications: A review of current evidence. Diabetologia. 2019;62(1):03-16.
[5] Centers for Disease Control and Prevention. Chronic Kidney Disease in the United States, 2023. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2023. Available from: https://www.cdc.gov/kidneydisease/pdf/CKD-Factsheet-H.pdf.
[6] ADA Guidelines American Diabetes Association. Diagnosis microvascular complication and foot care. Standards of medical care in diabetes. Diabetes Care. 2019;42(Suppl. 1):S124-38.
[7] Huang W, Huang J, Liu Q, Lin F, He Z, Zeng Z, et al. Neutrophil-lymphocyte ratio is a reliable predictive marker for early-stage diabetic nephropathy. Clin Endocrinol (Oxf). 2015;82(2):229-33.
[8] Horne BD, Anderson JL, John JM, Weaver A, Bair TL, Jensen KR, et al. Which white blood cell subtypes predict increased cardiovascular risk? J Am Coll Cardiol. 2005;45(10):1638-43.
[9] Wolf G, Ziyadeh FN. Cellular and molecular mechanisms of proteinuria in diabetic nephropathy. Nephron Physiol [Internet]. 2007;106(2):26-31.
[10] Goldfine AB, Shoelson SE. Therapeutic approaches targeting inflammation for diabetes and associated cardiovascular risk. J Clin Invest. 2017;127(1):83-93.
[11] Tian S, Chen SY. Macrophage polarization in kidney diseases. Macrophage (Houst). 2015;2(1):e679.
[12] Matoba K, Takeda Y, Utsunomiya K, Nishimura R. Unraveling the role of inflammation in the pathogenesis of diabetic kidney disease. Int J Mol Sci. 2019;20(14):3393.
[13] Khandare S, Chittawar S, Nahar N, Dubey TN, Qureshi Z. Study of neutrophil-lymphocyte ratio as novel marker for diabetic nephropathy in type 2 diabetes. Indian J Endocrinol Metab. 2017;21(3):387-92.
[14] Résimont G, Cavalier E, Radermecker RP, Delanaye P. Albuminuria in diabetic patients: How to measure it?- A narrative review. J Lab Precis Med [Internet]. 2022 [cited2024Feb24];7(4):01-10. Available from: https://jlpm.amegroups.org/article/view/6744/html.
[15] KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Journal of the International Society of Nephrology. 2013;3(1):01-150.
[16] Kothai G, Neha K, Patil AB, Malathy AR, Karthik SP. Neutrophil lymphocyte ratio as a marker of diabetic nephropathy. JEBMH. 2020;7(26):1223-27.
[17] Gupta N, Karoli R, Shanker Sing P, Shrivastava A. The relationship between neutrophil/lymphocyte ratio, albuminuria and renal dysfunction in diabetic nephropathy. JIACM. 2018;19(4):265-68.
[18] Akbas EM, Demirtas L, Ozcicek A, Timuroglu A, Bakirci EM, Hamur H, et al. Association of epicardial adipose tissue, neutrophil to lymphocyte ratio and platelet to lymphocyte ratio with diabetic nephropathy. Int J Clin Exp Med. 2014;7(7):1794-801.
[19] Gurmu MZ, Genet S, Gizaw ST, Feyisa TO, Gnanasekaran N. Neutrophil-lymphocyte ratio as an inflammatory biomarker of diabetic nephropathy among type 2 diabetes mellitus patients: A comparative cross-sectional study. SAGE Open Med. 2022;10:20503121221140231.
[20] Youssef Moursy E. Relationship between neutrophil-lymphocyte ratio and microvascular complications in Egyptian patients with type 2 diabetes. American Journal of Internal Medicine. 2015;3(6):250.
[21] Tutan D, Dogan M. Evaluation of neutrophil/lymphocyte ratio, low-density lipoprotein/albumin ratio, and red cell distribution width/albumin ratio in the estimation of proteinuria in uncontrolled diabetic patients. Cureus. 2023;15(8):e44497.

[22] Kahraman C, Kahraman N, Aras B, Coşgun S, Gülcan E. The relationship between neutrophil-to-lymphocyte ratio and albuminuria in type 2 diabetic patients: A pilot study. Int J Clin Exp Med. 2014;7(7):1794-801.

[23] Unal A, Kocyigit I, Çerçi I, Dogan E, Arıkan T, Sipahioglu MH, et al. Relationship between neutrophil/lymphocyte ratio and albuminuria in diabetic patients. Turk Nephrol Dial Transplant [Internet]. 2015;24(3):312-17.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of General Medicine, East Point Medical Sciences and Research Centre, Bengaluru, Karnataka, India.
2. Associate Professor, Department of General Medicine, East Point Medical Sciences and Research Centre, Bengaluru, Karnataka, India.
3. Assistant Professor, Department of General Medicine, Vydehi Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
N Pradeep,
4th Cross, Gayathri Layout, Basavanapura Main Road, K.R. Puram,
Bengaluru-560036, Karnataka, India.
E-mail: prad310@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Nov 06, 2023
- Manual Googling: Mar 11, 2024
- iThenticate Software: Mar 14, 2024 (15%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Oct 29, 2023**
Date of Peer Review: **Jan 14, 2024**
Date of Acceptance: **Mar 18, 2024**
Date of Publishing: **May 01, 2024**