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Diagnostic Utility of Neutrophil-to-Lymphocyte Ratio in Predicting Acute Bacterial Infections

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Abstract: Background: Acute bacterial infections are common causes of morbidity and hospitalization and require timely recognition for appropriate clinical management. The neutrophil-to-lymphocyte ratio (NLR), derived from routine complete blood count parameters, reflects the balance between innate inflammatory activation and adaptive immune response and may provide a useful marker for identifying bacterial infection. **Objectives:** To determine the diagnostic utility of the neutrophil-to-lymphocyte ratio in predicting acute bacterial infections. **Study Design & Setting:** A prospective cross-sectional diagnostic study was conducted in the Department of Department of Pathology Bahria University Health Sciences, Karachi from February 2025 to July 2025. **Methodology:** A total of 120 patients presenting with clinical features suggestive of acute infection were enrolled through consecutive sampling. Demographic and clinical characteristics were recorded, and venous blood samples were obtained at presentation. Complete blood count and differential leukocyte counts were performed, and NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. The final diagnosis of acute bacterial infection was established using predefined clinical, laboratory, and microbiological criteria where appropriate. Diagnostic performance of NLR was assessed using sensitivity, specificity, predictive values, diagnostic accuracy, and receiver operating characteristic (ROC) curve analysis. **Results:** Acute bacterial infection was present in 72 (60.0%) participants, while 48 (40.0%) had no bacterial infection. Mean NLR was significantly higher among participants with bacterial infection than those without bacterial infection (7.1 ± 4.3 vs. 3.5 ± 2.5, $p<0.001$). At an NLR cut-off of >4.0, sensitivity was 81.9%, specificity was 60.4%, positive predictive value was 75.6%, negative predictive value was 69.0%, and diagnostic accuracy was 73.3%. ROC analysis showed an AUC of 0.772 (95% CI: 0.684–0.860; $p<0.001$), with an optimal NLR cut-off of 4.2. **Conclusion:** NLR demonstrated significant discriminatory ability for acute bacterial infections and provided moderate diagnostic accuracy at an optimal cut-off of 4.2.

Keywords: Acute bacterial infection; Diagnostic accuracy; Inflammation; Neutrophil-to-lymphocyte ratio; ROC curve.

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INTRODUCTION

Acute bacterial infections are infectious conditions caused by pathogenic bacteria that invade normally sterile tissues or colonize susceptible body sites and provoke an inflammatory host response. They may involve the respiratory tract, urinary system, bloodstream, skin and soft tissues, or other organs, with clinical manifestations ranging from localized illness to systemic infection and sepsis.1,2 Bacterial infections arise through exposure to pathogenic organisms from community or healthcare environments, with transmission occurring through respiratory droplets, contaminated food or water, direct contact, wounds, invasive procedures, or endogenous spread from colonized sites.3 The responsible organisms include both Gram-positive and Gram-negative bacteria, with Staphylococcus aureus, Escherichia coli, Streptococcus pneumoniae, Klebsiella pneumoniae, and Pseudomonas aeruginosa among important contributors to severe disease.4

The global burden of bacterial disease remains substantial. A systematic analysis of the Global Burden of Disease Study estimated that 33 bacterial pathogens were associated with approximately 7.7 million deaths worldwide in 2019, accounting for 13.6% of all global deaths and 56.2% of sepsis-related deaths.5 The pathophysiological response to bacterial infection involves activation of innate immunity, recruitment of neutrophils, release of inflammatory mediators, and subsequent activation of adaptive immune mechanisms.6 Neutrophils constitute a major early cellular defense against bacterial pathogens through chemotaxis, phagocytosis, production of reactive oxygen species, and release of antimicrobial enzymes.7 In contrast, circulating lymphocyte numbers may decline during acute systemic inflammation because of stress-mediated redistribution, apoptosis, and altered immune regulation. The simultaneous rise in neutrophils and reduction in lymphocytes therefore produces an increased neutrophil-to-lymphocyte ratio (NLR), reflecting the balance between innate inflammatory activation and adaptive immune response.8

The NLR is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count obtained from a routine complete blood count. Because both components are readily available, the ratio can be derived without specialized testing. Its diagnostic performance has been investigated in bacterial infections and bloodstream infection.9,10 A systematic review and meta-analysis reported pooled sensitivity of 72.3% and specificity of 59.6% for NLR in detecting bacteraemia, with an area under the summary receiver operating characteristic curve of 0.69. Thus, NLR represents a readily obtainable hematological marker that reflects the inflammatory changes accompanying acute bacterial infection and can be assessed alongside established clinical and laboratory findings.11

Acute bacterial infections are common causes of morbidity and hospitalization, while early differentiation from non-bacterial inflammatory conditions remains clinically challenging. Most existing evidence originates from populations outside Pakistan, and there is limited locally generated evidence evaluating NLR specifically for identifying acute bacterial infections. This study will provide population-specific evidence on the diagnostic utility of NLR, including its ability to distinguish patients with acute bacterial infection according to the selected diagnostic reference standard. The findings will add to the existing literature by providing locally derived diagnostic estimates and an NLR threshold that can be evaluated against findings reported in previous international studies.

METHODS

A prospective cross-sectional diagnostic study was conducted at Department of Pathology Bahria University Health Sciences, Karachi over a period of six months from February 2025 to July 2025. A total of 120 patients who fulfilled the predefined eligibility criteria were enrolled through consecutive sampling. Using the previously reported sensitivity of 72.3% with a 95% confidence level and 10% absolute precision, the calculated sample size was approximately 78 patients. After allowing for incomplete data and to provide adequate precision for subgroup and ROC analysis, the final sample size was increased to 120 patients.[12]

Adult patients of either gender who presented with clinical features suggestive of an acute infection, such as fever, chills, productive cough, dysuria, localized pain, purulent discharge, or other clinically suspected infectious manifestations, were included. Patients with known hematological malignancies, chronic inflammatory or autoimmune diseases, active malignancy, recent major surgery or trauma, pregnancy, immunosuppressive therapy, corticosteroid use, or conditions known to substantially alter leukocyte counts were excluded. Patients with incomplete laboratory or clinical data were also excluded.

After obtaining written informed consent, relevant demographic and clinical information was recorded on a structured proforma. A venous blood sample was obtained from each participant at presentation before

initiation of antibiotic therapy, where clinically feasible. Complete blood count with differential leukocyte count was performed using the hospital laboratory's standard automated hematology analyzer. The absolute neutrophil and lymphocyte counts were recorded from the differential leukocyte count. The NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. This approach was consistent with previous diagnostic studies in which NLR was derived from routinely available hematological parameters.

The presence of acute bacterial infection was determined using the predefined clinical and laboratory diagnostic criteria, supported where appropriate by microbiological investigations such as culture and sensitivity. Patients were categorized into bacterial infection and non-bacterial/non-infectious groups according to the final diagnostic assessment. The primary outcome variable was the presence of an acute bacterial infection, while NLR was the principal predictor variable. Age, gender, presenting symptoms, total leukocyte count, neutrophil count, lymphocyte count, temperature, and relevant laboratory findings were also recorded as secondary variables.

Data were entered and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation or median with interquartile range according to data distribution, whereas categorical variables were presented as frequencies and percentages. The NLR values between the study groups were compared using an appropriate independent-samples statistical test. Receiver operating characteristic (ROC) curve analysis was performed to assess the diagnostic ability of NLR for identifying acute bacterial infection, and the area under the curve (AUC), sensitivity, specificity, positive predictive value, negative predictive value, and optimal cut-off value were calculated. A p-value of ≤0.05 was considered statistically significant.

RESULTS

The mean age of the study participants was 45.8 ± 16.2 years. The largest proportion of participants was aged 31–50 years (46, 38.3%), followed by those aged 51–70 years (38, 31.7%), while 24 (20.0%) participants were aged ≤30 years and 12 (10.0%) were aged >70 years. Males comprised 68 (56.7%) participants, whereas females comprised 52 (43.3%) participants, as shown in Table 1.

Table 1. Demographic characteristics of study participants (n=120)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	45.8 ± 16.2
Age group	≤30 years	24 (20.0)
	31–50 years	46 (38.3)
	51–70 years	38 (31.7)
	>70 years	12 (10.0)
Gender	Male	68 (56.7)
	Female	52 (43.3)

Fever was the most frequently recorded clinical feature, present in 102 (85.0%) participants, followed by cough in 52 (43.3%), chills/rigors in 48 (40.0%), localized pain in 44 (36.7%), dysuria in 31 (25.8%), and purulent discharge in 27 (22.5%). Tachycardia was present in 58 (48.3%) participants. The mean total leukocyte count was 12.4 ± 4.1 $\times 10^9$/L, while the mean absolute neutrophil and lymphocyte counts were 8.9 ± 3.5 $\times 10^9$/L and 1.9 ± 0.8 $\times 10^9$/L, respectively. The mean NLR was 5.7 ± 4.1 and the mean CRP level was 58.6 ± 46.8 mg/L, as given in Table 2.

Table 2. Clinical and laboratory characteristics of study participants (n=120)

Variable	n (%) / Mean ± SD
Fever	102 (85.0)
Chills/rigors	48 (40.0)
Cough	52 (43.3)
Dysuria	31 (25.8)
Localized pain	44 (36.7)
Purulent discharge	27 (22.5)
Tachycardia	58 (48.3)
Total leukocyte count ($\times 10^9$/L)	12.4 ± 4.1
Absolute neutrophil count ($\times 10^9$/L)	8.9 ± 3.5
Absolute lymphocyte count ($\times 10^9$/L)	1.9 ± 0.8
NLR	5.7 ± 4.1
CRP (mg/L)	58.6 ± 46.8

Among the 120 participants, acute bacterial infection was present in 72 (60.0%), whereas 48 (40.0%) participants did

not have an acute bacterial infection according to the final diagnostic assessment, as shown in Table 3.

Table 3. Distribution of participants according to final diagnosis (n=120)

Variable	Category	n (%)
Acute bacterial infection	Present	72 (60.0)
	Absent	48 (40.0)
Total		120 (100.0)

Participants with acute bacterial infection had a higher mean total leukocyte count than those without bacterial infection (14.1 ± 3.8 vs. 9.8 ± 2.9 $\times 10^9$/L, p<0.001). The mean absolute neutrophil count was also higher among participants with bacterial infection (10.5 ± 3.2 vs. 6.5 ± 2.1 $\times 10^9$/L, p<0.001), whereas the mean absolute lymphocyte count was lower (1.6 ± 0.6 vs. 2.3 ± 0.8 $\times 10^9$/L, p<0.001). The mean NLR was significantly higher in the bacterial infection group compared with the non-bacterial group (7.1 ± 4.3 vs. 3.5 ± 2.5, p<0.001). Similarly, mean CRP levels were higher among participants with bacterial infection (76.4 ± 48.2 vs. 31.9 ± 28.7 mg/L, p<0.001), as given in Table 4.

Table 4. Comparison of hematological parameters according to bacterial infection status

Variable	Bacterial infection present (n=72) Mean ± SD	Bacterial infection absent (n=48) Mean ± SD	p-value
Total leukocyte count ($\times 10^9$/L)	14.1 ± 3.8	9.8 ± 2.9	<0.001
Absolute neutrophil count ($\times 10^9$/L)	10.5 ± 3.2	6.5 ± 2.1	<0.001
Absolute lymphocyte count ($\times 10^9$/L)	1.6 ± 0.6	2.3 ± 0.8	<0.001
NLR	7.1 ± 4.3	3.5 ± 2.5	<0.001
CRP (mg/L)	76.4 ± 48.2	31.9 ± 28.7	<0.001

Using an NLR cut-off of >4.0, 59 (81.9%) of the 72 participants with acute bacterial infection had an NLR above the cut-off, compared with 19 (39.6%) of the 48 participants without bacterial infection. An NLR of ≤4.0 was observed in 13 (18.1%) participants with bacterial infection and 29 (60.4%) participants without bacterial infection. The association between NLR category and bacterial infection status was statistically significant (p<0.001), as shown in Table 5.

Table 5. Distribution of NLR according to bacterial infection status

Variable	Category	Bacterial infection present n (%)	Bacterial infection absent n (%)	Total n (%)
NLR	≤4.0	13 (18.1)	29 (60.4)	42 (35.0)
	>4.0	59 (81.9)	19 (39.6)	78 (65.0)
Total		72 (100.0)	48 (100.0)	120 (100.0)
p-value		<0.001		

At an NLR cut-off of >4.0, the sensitivity was 81.9% and specificity was 60.4%. The positive predictive value was 75.6%, while the negative predictive value was 69.0%. The overall diagnostic accuracy was 73.3%. The positive and negative likelihood ratios were 2.07 and 0.30, respectively, as given in Table 6.

Table 6. Diagnostic performance of NLR for prediction of acute bacterial infection at a cut-off of >4.0

Variable	Value
Sensitivity	81.9
Specificity	60.4
Positive predictive value	75.6
Negative predictive value	69.0
Diagnostic accuracy	73.3
Positive likelihood ratio	2.07
Negative likelihood ratio	0.30

DISCUSSION

Acute bacterial infections are common clinical conditions that produce systemic inflammatory responses and may progress to serious complications if not recognized promptly. They are caused by diverse bacterial pathogens and commonly involve the respiratory, urinary, gastrointestinal, skin, and bloodstream systems.[13] During bacterial infection,

neutrophil activation increases while circulating lymphocyte levels may decrease because of acute inflammatory and stress responses. The neutrophil-to-lymphocyte ratio (NLR) combines these two hematological changes and can be calculated easily from a routine complete blood count.[14] The present study evaluated NLR as a diagnostic marker for acute bacterial infection using clinical and laboratory assessment as the reference standard.

In the present study, acute bacterial infection was identified in 72 (60.0%) of 120 participants, while 48 (40.0%) had no bacterial infection. The mean NLR was significantly higher among patients with bacterial infection than those without bacterial infection (7.1 ± 4.3 vs. 3.5 ± 2.5, p<0.001), indicating a clear difference in the inflammatory hematological profile between the two groups. At an NLR cut-off of >4.0, 59 (81.9%) patients with bacterial infection had an elevated ratio compared with 19 (39.6%) patients without bacterial infection (p<0.001). The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were 81.9%, 60.4%, 75.6%, 69.0%, and 73.3%, respectively, while ROC analysis demonstrated an AUC of 0.772 (95% CI: 0.684–0.860, p<0.001), with an optimal NLR cut-off of 4.2.

Naess et al. (2017) similarly demonstrated that NLR was significantly associated with the final diagnostic category, with higher NLR values corresponding to a greater probability of bacterial infection and lower probability of viral infection. They further reported that patients with septicemia had significantly higher NLR values than patients with other bacterial infections when fever had been present for less than one week, whereas WBC count, neutrophil count, and CRP did not significantly differentiate septicemia from other bacterial infections. These findings were consistent with our results, in which NLR was significantly higher in the bacterial infection group (7.1 ± 4.3 vs. 3.5 ± 2.5, p<0.001), supporting the ability of NLR to reflect infection-related inflammatory changes. The higher discriminatory performance observed in our study, with an AUC of 0.772, also supports the diagnostic association reported by Naess et al., although differences in patient characteristics, infection spectrum, and reference diagnostic criteria may account for variation in diagnostic performance.

Jiang et al. (2019), in a systematic review and meta-analysis of eight studies evaluating NLR for bacteremia, reported a pooled sensitivity of 72.3% (95% CI: 66.0–77.7%), specificity of 59.6% (95% CI: 55.6–63.4%), and summary AUC of 0.69 (95% CI: 0.65–0.73). Our study demonstrated a higher sensitivity of 81.9% and a slightly higher specificity of 60.4%, while the AUC of 0.772 was also greater than the pooled value of 0.69. Similarly, the diagnostic accuracy in our study was 73.3%, suggesting somewhat stronger discriminatory performance than that observed in the pooled analysis. Nevertheless, the specificity remained relatively modest and the positive likelihood ratio was 2.07, which was compatible with Jiang et al.'s conclusion that NLR was useful as an accessible inflammatory marker but had limited ability to independently establish bacterial infection. The difference between the present findings and the pooled estimates may have reflected differences in study populations, infection types, disease severity, and NLR thresholds.

Ding et al. (2020) evaluated 588 non-neutropenic febrile patients with lung malignancy, including 311 with bacterial infection and 277 with tumor fever. Their NLR showed significant discriminatory ability, with an AUC of 0.792, which was very close to the AUC of 0.772 observed in our study. The difference between the two AUCs was only 0.020, indicating broadly comparable discriminatory performance despite differences in study populations. However, Ding et al. reported superior diagnostic performance for procalcitonin and CRP, with AUCs of 0.874 and 0.855, respectively, compared with 0.792 for NLR. In our study, CRP was also significantly higher among patients with bacterial infection than those without infection (76.4 ± 48.2 vs. 31.9 ± 28.7 mg/L, p<0.001), supporting the inflammatory distinction observed in their study. However, because our primary diagnostic analysis focused on NLR, direct comparison of diagnostic AUCs between NLR and CRP was not performed.

Noor et al. (2020) reported significant differences in blood and baseline characteristics between their study groups (p<0.001) and found that NLR, d-NLR, and PLR had significant diagnostic associations and were independently associated with disease severity. Their ROC analysis demonstrated larger areas under the curve for these hematological ratios, while binary logistic regression also showed significant associations with severity (p<0.001). The present findings were directionally consistent, as NLR showed significant discriminatory ability for bacterial infection, with an AUC of 0.772 (95% CI: 0.684–0.860, p<0.001). However, the outcome assessed in the Noor et al. study concerned disease severity, whereas our primary outcome was the presence of acute bacterial infection; therefore, the reported diagnostic associations were not directly equivalent.

Ghouri et al. (2023), in a Pakistani cross-sectional study of 123 adult patients with positive blood cultures, reported a mean NLR of 5.9 ± 13.1, with 45.5% of participants having a high NLR. Their mean CRP was 58.5 ± 68.7 mg/L. In our study, the overall mean NLR was 5.7 ± 4.1, which was remarkably close

to the 5.9 reported by Ghouri et al., while the mean CRP in our population was 58.6 ± 46.8 mg/L, almost identical to their reported 58.5 ± 68.7 mg/L. This close similarity in both NLR and CRP values supports consistency between our findings and Pakistani evidence. However, the populations differed because Ghouri et al. included patients with positive blood cultures, whereas our study included patients assessed for acute bacterial infection using clinical, laboratory, and microbiological criteria where appropriate. Despite this difference, both studies demonstrated an association between elevated NLR and bacterial infection.

Anoun et al. (2024) conducted a prospective study involving 164 adults with confirmed bacterial infections and non-infectious inflammatory conditions and reported a highly significant difference in NLR between the groups ($p<0.000001$). ROC analysis yielded an AUC of 0.72, with an optimal NLR cut-off of 4.3. Our findings were closely aligned with these results, as NLR had an AUC of 0.772 (95% CI: 0.684–0.860; $p<0.001$) and an optimal cut-off of 4.2. The difference between the optimal cut-offs was only 0.1, while the AUC in our study was 0.052 higher. Furthermore, our sensitivity of 81.9% and specificity of 60.4% demonstrated useful discriminatory performance at an NLR threshold close to that identified by Anoun et al. The similarity in cut-off values provides particularly strong concordance between the two studies despite differences in study setting and population.

Rizvi et al. (2025) reported significant differences in NLR between malaria and dengue patients, with malaria showing a higher mean NLR of 5.43 ± 4.56 compared with 2.72 ± 2.52 in dengue patients ($p<0.001$). A high NLR was observed in 58.2% of malaria patients, whereas a low NLR predominated in 84% of dengue patients ($p<0.001$). Although their study did not specifically evaluate NLR for diagnosing acute bacterial infection, the findings supported the ability of NLR to discriminate between infectious conditions with different inflammatory profiles. The mean NLR of 5.43 ± 4.56 reported by Rizvi et al. was also close to the overall mean NLR of 5.7 ± 4.1 in our study. However, their comparison involved malaria and dengue, whereas our study compared bacterial infection with absence of bacterial infection; therefore, the magnitude and direction of NLR differences should be interpreted within the respective clinical contexts.

STUDY LIMITATIONS

The study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings. The relatively small sample size of 120 participants may have limited the precision of diagnostic estimates and subgroup analysis. NLR can be influenced by several inflammatory, physiological, and medication-related factors, which may affect its diagnostic performance.

CONCLUSION

NLR was significantly higher among patients with acute bacterial infections than among those without bacterial infection. An NLR cut-off of >4.0 demonstrated 81.9% sensitivity and 60.4% specificity, with an overall diagnostic accuracy of 73.3%.

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Conflict of Interest: No

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BIBLIOGRAPHY

1. Anju VT, Busi S, Mohan MS, Dyavaiah M. Bacterial infections: Types and pathophysiology. InAntibiotics-Therapeutic Spectrum and Limitations 2023 Jan 1 (pp. 21-38).
2. Jeffrey M, Denny KJ, Lipman J, Conway Morris A. Differentiating infection, colonisation, and sterile inflammation in critical illness: the emerging role of host-response profiling. Intensive Care Medicine. 2023 Jul;49(7):760-71.
3. Rasquel-Oliveira FS, Ribeiro JM, Martelossi-Cebinelli G, Costa FB, Nakazato G, Casagrande R, Verri WA. Staphylococcus aureus in inflammation and pain: update on pathologic mechanisms. Pathogens. 2025 Feb 12;14(2):185.
4. Ahmed SA, Hasan HM, Sweedan EG. Antibacterial action of AgNPs produced from different isolates of Gram positive and Gram-negative bacteria on biofilm of Klebsiella pneumoniae isolated from RTI. Biomedicine. 2023 Jul 1;43(3):983-7.
5. Ikuta KS, Swetschinski LR, Aguilar GR, Sharara F, Mestrovic T, Gray AP, Weaver ND, Wool EE, Han C, Hayoon AG, Aali A. Global mortality associated with 33 bacterial pathogens in 2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2022 Dec 17;400(10369):2221-48.
6. Saez A, Herrero-Fernandez B, Gomez-Bris R, Sánchez-Martinez H, Gonzalez-Granado JM. Pathophysiology of inflammatory bowel disease: innate immune system. International journal of molecular sciences. 2023 Jan 12;24(2):1526.
7. Buchmann K. Neutrophils and aquatic pathogens. Parasite Immunology. 2022 Jun;44(6):e12915.
8. Arciola CR, Ravaioli S, Mirzaei R, Dolzani P, Montanaro L, Daglia M, Campoccia D. Biofilms in Periprosthetic orthopedic infections seen

through the Eyes of neutrophils: how can We help neutrophils?. International Journal of Molecular Sciences. 2023 Nov 23;24(23):16669.
9. Liu G, Geng J, Jin R, Zhang N, Mei L. The clinical significance of complete blood count, neutrophil-to-lymphocyte ratio, and monocyte-to-lymphocyte ratio in gestational diabetes mellitus. Acta Endocrinologica (Bucharest). 2024 Jun 24;19(4):441.
10. Kriplani A, Pandit S, Chawla A, de la Rosette JJ, Laguna P, Jayadeva Reddy S, Somani BK. Neutrophil–lymphocyte ratio (NLR), platelet–lymphocyte ratio (PLR) and lymphocyte–monocyte ratio (LMR) in predicting systemic inflammatory response syndrome (SIRS) and sepsis after percutaneous nephrolithotomy (PNL). Urolithiasis. 2022 Jun;50(3):341-8.
11. Zinellu A, Paliogiannis P, Mangoni AA. A systematic review and meta-analysis of the diagnostic accuracy of the neutrophil-to-lymphocyte ratio and the platelet-to-lymphocyte ratio in systemic lupus erythematosus. Clinical and experimental medicine. 2024 Jul 25;24(1):170.
12. Jiang J, Liu R, Yu X, Yang R, Xu H, Mao Z, Wang Y. The neutrophil-lymphocyte count ratio as a diagnostic marker for bacteraemia: A systematic review and meta-analysis. The American journal of emergency medicine. 2019 Aug 1;37(8):1482-9.
13. Izquierdo-Condoy JS, Vasconez-Gonzales J, Morales-Lapo E, Tello-De-la-Torre A, Naranjo-Lara P, Fernandez R, Hidalgo MR, Escobar A, Yepez VH, Díaz AM, Oliva C. Beyond the acute phase: a comprehensive literature review of long-term sequelae resulting from infectious diseases. Frontiers in Cellular and Infection Microbiology. 2024 Jan 31;14:1293782.
14. Sikora JP, Karawani J, Sobczak J. Neutrophils and the systemic inflammatory response syndrome (SIRS). International Journal of Molecular Sciences. 2023 Aug 30;24(17):13469.
15. Naess A, Nilssen SS, Mo R, Eide GE, Sjursen H. Role of neutrophil to lymphocyte and monocyte to lymphocyte ratios in the diagnosis of bacterial infection in patients with fever. Infection. 2017 Jun;45(3):299-307.
16. Anoun J, Ajmi M, Riahi S, Dhaha Y, Mbarki D, ben Hassine I, Romdhane W, Baya W, Adaily N, Mzabi A, Fredj FB. Neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios in bacterial infections: contributions to diagnostic strategies in a tertiary care hospital in Tunisia. F1000Research. 2024 Sep 25;13:978.
17. Ghouri AK, Khurshid S, Tariq R, Qadir A, Butt M, Memon A. Role of neutrophils to lymphocytes ratio in identification of bacterial infection in adult population. Journal of Fatima Jinnah Medical University. 2022;16(3):115-8.
18. Ding S, Ma J, Song X, Dong X, Xie L, Song X, Liu L. Diagnostic accuracy of procalcitonin, neutrophil-to-lymphocyte ratio, and C-reactive protein in detection of bacterial infections and prediction of outcome in nonneutropenic febrile patients with lung malignancy. Journal of Oncology. 2020;2020(1):2192378.
19. Rizvi SM, Hassan M, Iqbal M, Shams M, Jiskani SA, Shabbir A. Neutrophil-to-lymphocyte ratio as a diagnostic marker: A comparative study in dengue and malaria patients. Pakistan Journal of Pathology. 2025 Dec 30;36(4):270-6.
20. Noor A, Akhtar F, Tashfeen S, Anwar N, Saleem B, Khan SA, Akram Z, Shahid S. Neutrophil-to-Lymphocyte Ratio, derived Neutrophil-to-Lymphocyte Ratio, Platelet-to-Lymphocyte Ratio and Lymphocyte-to-Monocyte Ratio as risk factors in critically ill COVID-19 patients, a single centered study. Journal of Ayub Medical College Abbottabad. 2020;32(4-Sup 1):595-601.

