



Diagnostic Value of Systemic Immune - Inflammation Index in Pre-Operative Acute Appendicitis : A Cross Sectional Study at Reference Tertiary Hospital of Hodeidah, Yemen

Najeeb Othman^{1,2 ^}, Sanad Kashah^{1,2}, Yasser A. Obadiel³, Sulaiman Moogam^{1,4*}

¹ Yemeni Board of Medical and Health Specialization , Hodeidah Branch , Yemen, E-mail: najeebothman9@gmail.com

² Department of Surgery – Authority of AL Thawara Public Hospital Authority , Hodeidah , Yemen E-mail: sand775370853@gmail.com

³ Arab and Yemeni Board of Medical and Health Specialization , Sana'a , Yemen, E-mail: obadiel@su.edu.ye

⁴ Department of Surgery , Faculty of Medicine and Surgery, Hodeidah University, Hodeidah, Yemen E-mail: smagaam@yahoo.com

*Corresponding author E-mail: smagaam@yahoo.com; najeebothman9@gmail.com

Received: 19 June 2026 . Accepted: 27 June 2026 . Published: 30 June 2026.

Abstract

Background: Acute appendicitis is a common surgical emergency with variable clinical severity, ranging from uncomplicated inflammation to complicated forms associated with perforation and increased morbidity. Early identification of complicated cases is essential for optimal management. Recent evidence suggests that inflammatory biomarkers, particularly the Systemic Immune-Inflammation Index (SII), may improve pre-operative risk stratification. **Objective:** This study aimed to evaluate the diagnostic performance of SII in distinguishing uncomplicated from complicated acute appendicitis. **Methodology :** A cross-sectional study was conducted on 255 patients with clinically confirmed acute appendicitis. Sociodemographic, clinical, and laboratory data were analyzed. SII was calculated from complete blood count parameters. Patients were classified into uncomplicated and complicated appendicitis groups. Statistical analysis included comparison of means, Mann–Whitney U test, receiver operating characteristic (ROC) curve analysis, and binary logistic regression. **Results:** The mean age of participants was 14.5 ± 2.9 years, with males forming the majority. Right lower quadrant pain, fever, nausea, vomiting, and anorexia were the most common presenting symptoms. The mean SII was 2011.4 ± 1807.4 . Patients with complicated appendicitis (25.1%) demonstrated significantly higher SII levels compared to those with uncomplicated appendicitis (3849.3 vs. 1395.5; $p < 0.001$). ROC analysis showed excellent diagnostic performance of SII with an AUC of 0.881 (95% CI: 0.812–0.950). With a cut-off value of 2384 (95% CI: 2150 – 2620) used to determine the optimal level, the results showed a sensitivity of 70.3% (95% CI: 57.6% – 81.1%), specificity of 91.6% (95% CI: 86.8% – 95.1%), PPV of 73.8% (95% CI: 60.9% – 84.2%), and NPV of 90.2% (95% CI: 85.1% – 94.0%). This study suggests that the SII clearly beats random guessing and can serve as a reliable clinical marker for identifying complications. Logistic regression revealed that SII was an independent predictor of complicated appendicitis (OR = 2.91 per 1000-unit increase; 95% CI: 2.15–3.94; $p < 0.001$). **Conclusion:** SII is an independent and economic biomarker for predicting complicated acute appendicitis with high specificity and good overall diagnostic accuracy. It may serve as a valuable adjunct tool in early pre-operative risk stratification when used alongside clinical and imaging findings.

Keywords: Acute appendicitis, SII, ROC curve, Biomarkers

1. Introduction

Acute appendicitis is the most frequently seen surgical emergency and is still considered a major cause of acute abdominal pain that requires urgent surgery. Although there have been great studies made in diagnostics methods, diagnosing this condition and recognizing those at risk of complicated appendicitis remains difficult. Inaccurate diagnosis can lead to perforation, gangrene, abscess formation, peritonitis, extended hospitalization and additional costs. It is thus important to recognize the severity of the condition early enough to improve chances of recovery [1].

The accuracy of imaging tools in the diagnosis of acute appendicitis has improved. Ultrasonography is commonly used as the primary modality due to its non-invasiveness, availability, and absence of ionizing radiation. New studies have indicated that ultrasound has been accurate in the diagnosis of appendicitis, but this might depend on the skill level of the operator and other factors pertaining to the patient [2]. Computed tomography (CT) has been the high accurate tool for diagnosing appendicitis; even without contrast media, the sensitivity and specificity have been high in emergency settings, but issues of radiation exposure and resource utilization have been limiting its widespread use [3].

In light of these drawbacks, researchers have increasingly started paying attention to the use of laboratory markers for diagnosis. From these biomarkers, one of the most useful is the Systemic Immune-Inflammation Index (SII), which is estimated based on platelets, neutrophils, and lymphocytes. Recent studies have shown that SII can be used to diagnose acute appendicitis and evaluate the severity of the disease [4].

SII's value has also been reinforced by pediatric research which similarly demonstrated statistically higher levels in children who had acute appendicitis when compared to the control group. The results indicate that SII might be useful in diagnostics prior to surgery in terms of being an easily accessible biomarker [5]. Moreover, there is growing evidence about the role of inflammatory indices as predictors of complicated appendicitis. The research on several inflammatory markers showed that complex indices were often more effective than traditional lab tests in differentiation of perforated/gangrenous appendicitis and uncomplicated forms [6].

There are some studies focused on the predictive power of SII in cases of complicated appendicitis. It is still being investigated." that increased levels of SII indicate more severe stages of the disease, such as perforation and abscess formation. These results have also been demonstrated by other researchers who conducted studies on blood biomarkers of uncomplicated and complicated appendicitis [7,8].

Other hematological parameters have also been extensively studied. Neutrophil lymphocyte ratio (NLR) has proven to be a good predictor of acute appendicitis, as was shown in a recent meta-analysis in children [9]. In addition, procalcitonin proved to be a useful tool in diagnosing complicated appendicitis in particular, although the clinical utility of this test is restricted by costs [10]. However, classical laboratory tests still remain relevant to the diagnosis of this disease. In a systematic analysis, the accuracy of procalcitonin, CRP, and WBC tests was assessed, showing that these parameters can assist in diagnosing appendicitis, although their accuracy may vary [11].

In a similar fashion, studies conducted in pediatric emergency medicine have established that laboratory indicators can increase the level of confidence in the diagnosis but need to be interpreted in conjunction with clinical and radiologic findings [12]. Beyond aiding in diagnosis, the utility of inflammatory markers goes even further. In large patient populations with presentation of acute abdominal pain, researchers have found that CRP levels and leukocyte counts help in distinguishing between urgent and non-urgent cases, thereby underlining their significance in the context of surgical emergencies [13]. Besides, meta-analysis studies have confirmed that not only does NLR predict acute appendicitis, but it can distinguish complicated from uncomplicated disease [14].

Despite their wide usage, however, predictive efficiency of conventional lab values for the severity of the disease is not always very high. The analysis of numerous cases of appendicitis revealed that no standard laboratory value can predict perforation of the appendix reliably enough. This explains why nowadays researchers pay more attention to developing inflammatory markers that could describe the underlying disease mechanisms better [15].

Over the past few years, SII has become a focal point for many researchers due to the fact that it incorporates information about neutrophils, lymphocytes, and platelets into one single index of systemic inflammation and immunity. The diagnostic value of this indicator in various populations is insufficiently studied, particularly the lack of SII studies in resource-limited settings like Yemen. Hence, an analysis of the clinical utility of this inexpensive and readily available marker in patients with acute appendicitis becomes relevant.

2. Methodology

2.1. Study Area - Setting and Period

Governorate of Hodeidah is situated at the west coast of Red Sea in Yemen. It is one of the densest populated governorates in the whole country. The governorate of Hodeidah experiences a hot tropical climate, which is marked by extremely hot and humid weather during most of the year. This makes the environment favorable for the occurrence of some infectious and tropical diseases [16,17]. This study was conducted at the General Surgery Department – Authority of Public Al-Thawra Hospital, a tertiary referral hospital located in Hodeidah, Yemen. The emergency department receives a high volume of patients presenting with acute abdominal conditions, including suspected acute appendicitis. The study was carried out between January 2024 and June 2025.

2.2. Study Design

An cross sectional study was done at the hospital setting on the diagnostic significance of the SII for pre-operative assessment of acute appendicitis. The subjects were recruited consecutively and followed up to the time of operation with confirmation of diagnosis through histopathology.

2.3. Study Population

The study population consisted of all patients admitted with a clinical diagnosis of acute appendicitis and scheduled for appendectomy at the Hospital during the study period.

Inclusion Criteria

- Patients with clinically suspected acute appendicitis.
- Patients undergoing emergency appendectomy.
- Availability of pre-operative complete blood count results.
- Provision of informed consent.

Exclusion Criteria

- Patients with hematological disorders.
- Patients with incomplete laboratory or clinical data
- Age more than 18 years old

2.4. Sample Size and Sampling Method

A total of 255 patients were included in the study. A consecutive sampling technique was employed whereby all eligible patients presenting during the study period were recruited until the required sample size was reached.

2.5. Ethical Consideration

The ethical approval for the study was provided by the Research Ethics Committee of the Yemeni Council of Medical and Health Specialization, Hodeidah, Yemen. The consent was taken from all the participants or their guardians in written form before recruiting them into the study. Participation in this study was voluntary, and it was also made clear to the participants that they had the right to leave the study at any point without having any effect on their medical treatment. The confidentiality of the participants was ensured by using identification codes rather than patient names.

2.6. Data Collection Methods

The data were collected and entered in sheet. The following variables were measured: Sociodemographic Variables : Age, Sex. Clinical Variables: duration of symptoms, abdominal pain, fever, nausea and vomiting. Physical Examination Operative Findings: simple appendicitis, perforated appendicitis, periappendicular abscess, Appendicular Mass and peritonitis.

2.7. Laboratory Procedure

Blood samples were obtained from all patients upon admission before administration of antibiotics and before surgery. Complete blood count (CBC) analysis was performed using an automated hematology analyzer (Sysmax) according to standard laboratory procedures. The following parameters were recorded:

- Total white blood cell count (WBC)
- Neutrophil count ($10^9/L$)
- Lymphocyte count ($10^9/L$)
- Platelet count ($10^9/L$)

Additional laboratory investigations, including C-reactive protein (CRP) was measured, were performed according to hospital protocols when available. Quality control procedures were implemented routinely in the laboratory to ensure accuracy and reliability of test results.

2.8. SII Calculation

The SII was calculated using the following equation:

$$SII = \frac{PxN}{L}$$

Where:

- P: Platelet Count = $\times 10^9/L$
- N: Neutrophil Count = $\times 10^9/L$
- L: Lymphocyte Count = $\times 10^9/L$

Higher SII values indicate a greater degree of systemic inflammatory response. Patients were subsequently classified into uncomplicated and complicated appendicitis groups according to operative finding.

2.9. Statistical Analysis

Data were entered, cleaned, and analyzed using Statistical Package for Social Sciences (SPSS) version 27.

Descriptive Statistics

- Frequencies (n) and percentages (%) were used for categorical variables.
- Mean $\pm$ standard deviation (SD) and range was used for normally distributed continuous variables.

Inferential Statistics

- Chi-square goodness and Mann-Whitney U test were used in this study.
- Operating Characteristic (ROC) curve analysis was performed to assess the diagnostic performance of SII.

- Area Under the Curve (AUC), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and optimal cutoff value were calculated.
- Logistic regression analysis was performed to evaluate the association between SII and complicated appendicitis and to estimate odds ratios (ORs) with 95% confidence intervals (CIs).
- A p -value less than 0.05 was considered statistically significant throughout the analysis

3. Results

3.1. Sociodemographic Characteristics of Patients

The demographic data was summarized in Table 1, the patients aged less than 18 years, with mean age of 14.5 ± 2.9 years and the age ranging from 4 to 18 years. There was a marked male preponderance in the study (p -value = 0.0006). Demographically there was considerable variability in terms of age of the participants in the study (p -value < 0.001), with the 11 to 18 year age group accounting for most of the population (90.2%, $n=230$), followed by 8.6% ($n=22$) in the 6 to 10 year age group and only 1.2% ($n=3$) in the ≤ 5 year age group (Table 1).

Table 1. Sociodemographic Characteristics of Patients ($n = 255$)

Sex and Age	Total (n)	%	p -value
≤ 5	3	1.2%	$p < 0.001$
6-10	22	8.6%	
11-18	230	90.2%	
Sex			$p = 0.0006$
Males	155	60.8	
Females	100	39.2	

3.2. Clinical Characteristics of Patients

It was noted in Table 2 that the clinical picture for the patients in the research had variations with right lower quadrant (RLQ) pain being the most common symptom. Other symptoms included anorexia, which was the most common occurring in 252 (98.8%) patients, followed by rebound tenderness in 219 (85.9%) patients. Moreover, fever occurred in 172 (67.5%) patients while nausea/vomiting was experienced in 138 (54.1%) patients. The period between symptom onset and hospital presentation was between 1 day and 7 days (2.5 ± 1.2). In addition, the temperature, heart rate, respiratory rate, blood pressure were summarized in Table 2.

Table 2. Clinical Characteristics of Study Participants (N:255)

Clinical Variable	(n;%)
Right lower quadrant pain	Majority
Fever	172 (67.5%)
Nausea/Vomiting	138 (54.1%)
Anorexia	252 (98.8%)
Rebound tenderness	219 (85.9%)
Variable	Mean $\pm$ SD
Duration of Symptoms (days)	2.5 ± 1.2
Temperature ($^{\circ}\text{C}$)	37.8 ± 0.6
Heart Rate (bpm)	92.4 ± 6.8
Respiratory Rate (b/min)	18.2 ± 2.1
Systolic BP (mmHg)	115.2 ± 12.4
Diastolic BP (mmHg)	72.5 ± 1807.4

3.3. Laboratory Parameters

Preoperative laboratory tests conducted comprised the complete blood count parameters and the inflammatory markers. These parameters included the white blood cell count, neutrophil count, lymphocyte count, platelet count and SII (Table 3).

Table 3. Laboratories Values in Study Participants (N:255)

Variable	Mean $\pm$ SD
WBC count ($10^9/\text{L}$)	13.5 ± 5.4
Neutrophil Percentage (%)	76.5 ± 13.2
Lymphocytes Percentage (%)	18.9 ± 11.1
Platelet Percentage (%)	326.1 ± 88.2
CRP (mg/L)	33.7 ± 24.9
SII	2011.4 ± 1

3.4. Comparison of SII Levels Between Uncomplicated and Complicated Appendicitis

The patients were classified as uncomplicated or complicated according to clinical and laboratories findings (Table 4). Complicated appendicitis patients had significantly high SII values compared to the patients with uncomplicated appendicitis. The result of Mann-Whitney U test revealed a highly significant difference between the two groups ($U=10,764$, $p < 0.001$).

Table 4. Distribution of Appendicitis Severity

Type of Appendicitis	n	(%)	Mean SII
Uncomplicated	191	74.9	1395.5
Complicated	64	25.1	3849.3
Total	255	100	-

3.5. Diagnostic Validation of SII

From the ROC curve results, the SII appears to be a powerful tool in identifying patients at risk of developing complicated appendicitis (Figure 1). The ROC curve gives an excellent area under the AUC of 0.881 (95% CI: 0.812-0.950). With the use of the optimal cutoff value of 2384 (95% CI: 2150-2620), the test has a sensitivity of 70.3% (95% CI: 64.1-76.5) and a specificity of 91.6% (95% CI: 88.3-94.9), a Positive Predictive Value (PPV) of 73.8% (95% CI: 60.9 – 84.2%), and a Negative Predictive Value (NPV) of 90.2% (95% CI: 85.1 – 94.0%). The result was greatly higher than the threshold of pure guessing (AUC = 0.500), highlighting the predictive value of the index in clinical practice.

Table 5. Diagnostic Performance of SII

Parameter	Value	CI 95 %
Area Under Curve (AUC)	0.881	0.812 – 0.950
Optimal cutoff value	2384	2150-2620
Sensitivity	70.3%	57.6% – 81.1%
Specificity	91.6%	86.8% – 95.1%
Positive Predictive Value (PPV)	73.8%	60.9% – 84.2%
Negative Predictive Value (NPV)	90.2%	85.1% – 94.0%

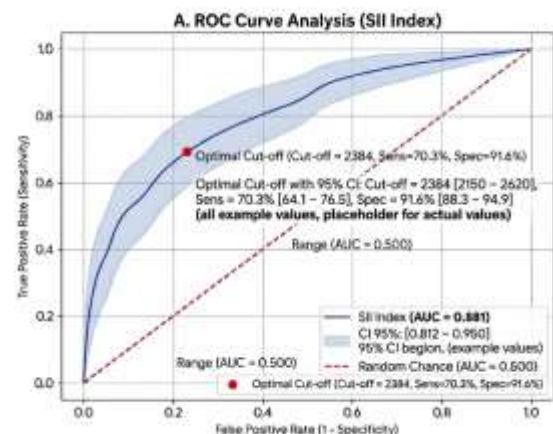


Figure 1. ROC Curve Analysis of SII for Predicting Complicated Appendicitis in Pediatric Patients

3.7. Prediction of SII for complication of Appendicitis

Logistic regression analysis was performed to evaluate whether SII independently predicted complicated appendicitis. The logistic regression model was statistically significant ($\chi^2 = 94.55$, $p < 0.001$). An increase in SII was associated with a 2.91-fold increase in the odds of complicated appendicitis (95% CI: 2.15-3.94).

4. Discussion

The current cross sectional study demonstrates that SII is an important biomarker for the preoperative evaluation of acute appendicitis. In particular, the study revealed that the SII levels were much higher among patients suffering from complicated appendicitis in comparison with those of uncomplicated appendicitis

(3849.3 vs. 1395.5; $p < 0.001$). Therefore, increased levels of inflammation correspond to severe forms of the disease. Moreover, SII showed outstanding diagnostic accuracy, since its AUC, sensitivity, and specificity resulted in 0.881, 70.3%, and 91.6%, respectively. Also, indicators SII had an independent prediction value of complicated appendicitis (OR = 2.91; 95% CI: 2.15-3.94). The age distribution of the current study demonstrated that patients' mean age was 14.5 ± 2.9 years, meaning that the acute appendicitis primarily affects the younger population. As a result, these findings correlate with the study of Kahramanca et al., who stated that inflammatory markers are especially helpful when examining young patients, in whom the disease usually shows increased systemic inflammatory reactions [18].

The marked elevation of SII in patients with complicated appendicitis corresponds to the results obtained by Aydin et al. showing an increase of laboratory parameters progressively in parallel with appendiceal condition and indicating higher inflammatory reactions in perforated appendicitis compared with simple appendicitis. The 2.8-fold elevation of SII in the current research study indicates strong neutrophil activation, lymphocyte inhibition, and platelet stimulation during severe appendiceal inflammation [19].

Similar findings were obtained in another study conducted by Aydin and Tatliparmak, who examined the diagnostic capability of SII in elderly patients and found that there was a significant correlation between SII levels and the severity of acute appendicitis. While the study population differed in that it was made up of mostly children and adolescents compared to the elderly subjects in the aforementioned research, they both show that SII can be considered an effective inflammatory biomarker regardless of age. [20]

The results observed here are also in agreement with those reported by Torun et al., where it was observed that noninvasive markers of inflammation, especially SII, can successfully differentiate uncomplicated and complicated cases of appendicitis. In their study, it was shown that raised levels of inflammatory indices were seen in perforated/gangrenous cases. This further emphasizes the present observation wherein complicated appendicitis is associated with higher levels of systemic inflammation [21].

The role of some hematological indicators such as red blood cell distribution width, mean platelet volume, and platelet distribution width was evaluated in children with acute appendicitis by Antić et al. [22]. This research has emphasized the significance of platelet-dependent parameters in the case of appendiceal inflammation. Given the role of platelets as the key constituents of SII, the current results provide additional evidence on the role of platelet activation in the pathogenesis of complicated appendicitis. Increased platelet count may be involved in inflammation and tissue damage, thus leading to increased SII in the case of severe disease. Furthermore, there is an extensive body of literature which stresses the difference between uncomplicated and complex appendicitis. In particular, Şimşek et al. [23] revealed that there are substantial imaging differences between these conditions as perforation, abscess formation, and damage of the appendiceal wall were linked with more serious course of disease. Higher SII values detected in the current study are probably associated with these pat-terms of disease.

In addition to the diagnostic performance measured in the current study, the excellent results achieved have been additionally confirmed by the research conducted by Avanesov et al. [24] and aimed at developing a predictive model of complicated appendicitis using the Appendicitis Severity Index (APSI), which integrates both clinical and imaging data. It was demonstrated by the authors that the correct preoperative assessment of the disease severity improves decision-making. In addition, the high AUC equal to 0.881 observed in the current study indicates that the SII can be applied to develop predictive models and increase diagnostic precision in future studies. The 91.6% of specificity achieved at the SII cut-off point of 2384 indicates a good ability to identify patients without complicated appendicitis. This result is clinically significant and can be considered additional to the research performed by Kessler et al. [25]. The latter authors demonstrated that laboratory parameters used together with ultrasonography and Doppler ultrasound improve diagnostic performance.

Results obtained at the moment are in line with previous research carried out by Berhuni et al. [26]. The authors focused on the diagnostic utility of SII in complicated appendicitis cases and found significantly higher SII levels in patients with perforated and gangrenous disease. In both studies, the authors supported the idea that SII is an indicator of the degree of systemic inflammation and can exceed other inflammatory markers in the assessment of disease severity. Erkent et al. [27] described the concept of using decision tree for appendicitis management and underlined the significance of laboratory marker inclusion into predictive algorithms. Excellent predictive abilities of SII obtained in this study can serve as the ground for using SII in decision trees for prediction purposes.

Similarly, Uludağ et al. [28] showed that routine preoperative blood test findings contribute to the prediction of complicated appendicitis. These results correlate with the current study because SII is based on routinely available CBC parameters, making it relatively cheap and readily available as a biomarker for use in daily practice. The dynamics of inflammatory markers were examined by Kaminskas et al. [29] in patients with suspected appendicitis, and they found that changes in inflammatory markers occur during the development and course of symptoms. This phenomenon may be the cause of wide variability of SII values in the current study as patients presented themselves at different stages of inflammation.

In the same way, Atema et al. [30] found that the diagnostic utility of white blood cell count and C-reactive protein depends on the length of symptom duration. The limitations of conventional lab biomarkers may partly account for why the SII index had better prediction capability in the present study. Considering the fact that SII incorporates three different markers, this score may be a better indicator of systemic inflammation compared to individual conventional lab biomarkers. Finally, Leeuwenburgh et al. [31] proposed a clinical decision rule for those who had indeterminated sonographic findings and have found that lab parameters could aid in making a diagnosis in case imaging tests are indeterminate. High specificity and excellent predictive value of SII make this index a good choice for incorporation into clinical decision rules, especially in limited resource settings.

Overall, the findings of the present study are highly consistent with previous literature and provide further evidence that SII is a reliable and clinically useful biomarker for predicting complicated acute appendicitis. The significant elevation of SII among complicated cases, its excellent diagnostic performance (AUC = 0.881), and its independent predictive value (OR = 2.91) support its incorporation into routine pre-operative assessment protocols. Given its simplicity, low cost, and availability from standard complete blood count testing, SII may be particularly valuable in resource-constrained healthcare settings such as Yemen. Our finding have important implications for clinical practice, particularly in resource-limited healthcare settings such as Yemen. Since SII is calculated from routine complete blood count parameters, it does not require additional laboratory testing or increase healthcare costs. The incorporation of SII into routine assessment protocols may assist clinicians in:

- Early identification of complicated appendicitis.
- Risk stratification before surgery.
- Prioritization of emergency surgical intervention.
- Reduction of diagnostic uncertainty.
- Optimization of resource allocation in emergency departments.

Study Limitation: The study was limited due to single-center design, lack of external validation, consecutive sampling (potential selection bias), missing data on inter-observer reliability and lack of comparison with other inflammatory markers.

5. Conclusion

This research revealed the diagnostic effectiveness of the SII in predicting complicated appendicitis, as proven by the excellent AUC value. High sensitivity and specificity with a highly negative predictive value, prove that the SII index is a clinically important

parameter. It is therefore concluded that the SII index can be regarded as a valuable and objective instrument in early patient diagnosis and risk stratification, and its use should be implemented into preoperative evaluation protocol.

Authors' contributions

N. Othman: Methodology, formal analysis, software Supervision and writing-review and editing; **Kashah:** Conceptualization, Methodology, formal analysis; **Y.A. Obadiel and : S Moogam :** Supervisor and Investigation, validation. All authors reviewed and approved the final manuscript.

Data Availability : The data that support this study are available from the corresponding author upon reasonable request

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

We would like to thanks statistical department - Laboratory Department - Authority of Public AL Thawara Hospital , Hodiedah, Yemen for supporting this project.

How to Cite : Othman N., Kashah S., Obadiel Y.A., Moogam S. (2026). Diagnostic Value of Systemic Immune - Inflammation Index in Pre-Operative Acute Appendicitis : A Cross Sectional Study at Reference Tertiary Hospital of Hodeidah, Yemen. *Abhath Journal of Basic and Applied Sciences*, 5(1), 26–31.

References

- Arredondo Montero, J., Delgado-Miguel, C., Pérez Riveros, B. P., Fernández-Atuan, R., & Rico-Jiménez, M. (2025). Systemic Immune-Inflammation Index for the Diagnosis of Acute Appendicitis: A Systematic Review. *The Journal of surgical research*, 309, 88–102. <https://doi.org/10.1016/j.jss.2025.03.002>
- Arredondo Montero, J., & Rico-Jiménez, M. (2026). Diagnostic performance of Doppler ultrasound for acute appendicitis: A systematic review and diagnostic test accuracy meta-analysis. *European journal of radiology*, 195, 112538. <https://doi.org/10.1016/j.ejrad.2025.112538>
- Oh S. K. (2025). Diagnostic Accuracy of Non-Contrast CT for Acute Appendicitis in the Emergency Department: A Systematic Review and Meta-Analysis. *Medicina (Kaunas, Lithuania)*, 61(12), 2163. <https://doi.org/10.3390/medicina61122163>
- Şener, K., Çakır, A., Kılavuz, H., Altuğ, E., & Güven, R. (2023). Diagnostic value of systemic immune inflammation index in acute appendicitis. *Revista da Associação Médica Brasileira* (1992), 69(2), 291–296. <https://doi.org/10.1590/1806-9282.20221003>
- Firinci, B., Aydın, C., Yunluel, D., Ibrahim, A., Yigiter, M., & Ahiskalioglu, A. (2025). The Role of Systemic Immune-Inflammation Index (SII) in Diagnosing Pediatric Acute Appendicitis. *Diagnostics (Basel, Switzerland)*, 15(15), 1942. <https://doi.org/10.3390/diagnostics15151942>
- Ortiz-Ley, J. D., Rodríguez-Zepeda, A. D. R., Paque-Bautista, C., González, A. P., Cano-Rodríguez, M. T., Cortés-Salim, P., Gómez-Coles, A., & Sosa-Bustamante, G. P. (2023). Índices inflamatorios predictores de apendicitis aguda complicada en niños [Inflammatory indexes predictors of complicated acute apendicitis in children]. *Revista medica del Instituto Mexicano del Seguro Social*, 61(Suppl 2), S161–S170.
- Tekeli, A., Çalışkan, M. B., Bahadır, G. B., & Erdemir, Ö. K. (2023). Evaluation of systemic immune-inflammation index efficacy in predicting complicated appendicitis in pediatric emergency department. Çocuk acilde komplike apandisitisi öngörmede sistemik immün inflamasyon indeksi etkinliğinin değerlendirilmesi. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES, 29(5), 566–573. <https://doi.org/10.14744/tjtes.2022.42472>
- Ha, S. C., Tsai, Y. H., Koh, C. C., Hong, S. G., Chen, Y., & Yao, C. L. (2024). Blood biomarkers to distinguish complicated and uncomplicated appendicitis in pediatric patients. *Journal of the Formosan Medical Association = Taiwan yi zhi*, 123(10), 1093–1098. <https://doi.org/10.1016/j.jfma.2024.01.023>
- Eun, S., Ho, I. G., Bae, G. E., Kim, H., Koo, C. M., Kim, M. K., & Yoon, S. H. (2021). Neutrophil-to-lymphocyte ratio for the diagnosis of pediatric acute appendicitis: a systematic review and meta-analysis. *European review for medical and pharmacological sciences*, 25(22), 7097–7107. <https://doi.org/10.26355/eurrev.202111.27263>
- Cui, W., Liu, H., Ni, H., Qin, X., & Zhu, L. (2019). Diagnostic accuracy of procalcitonin for overall and complicated acute appendicitis in children: a meta-analysis. *Italian journal of pediatrics*, 45(1), 78. <https://doi.org/10.1186/s13052-019-0673-3>
- Yu, C. W., Juan, L. L., Wu, M. H., Shen, C. J., Wu, J. Y., & Lee, C. C. (2013). Systematic review and meta-analysis of the diagnostic accuracy of procalcitonin, C-reactive protein and white blood cell count for suspected acute appendicitis. *The British journal of surgery*, 100(3), 322–329. <https://doi.org/10.1002/bjs.9008>
- Kwan, K. Y., & Nager, A. L. (2010). Diagnosing pediatric appendicitis: usefulness of laboratory markers. *The American journal of emergency medicine*, 28(9), 1009–1015. <https://doi.org/10.1016/j.ajem.2009.06.004>
- Gans, S. L., Atema, J. J., Stoker, J., Toorenvliet, B. R., Laurell, H., & Boermeester, M. A. (2015). C-reactive protein and white blood cell count as triage test between urgent and nonurgent conditions in 2961 patients with acute abdominal pain. *Medicine*, 94(9), e569. <https://doi.org/10.1097/MD.0000000000000569>
- Hajibandeh, S., Hajibandeh, S., Hobbs, N., & Mansour, M. (2020). Neutrophil-to-lymphocyte ratio predicts acute appendicitis and distinguishes between complicated and uncomplicated appendicitis: A systematic review and meta-analysis. *American journal of surgery*, 219(1), 154–163. <https://doi.org/10.1016/j.amjsurg.2019.04.018>
- Sevinç, M. M., Kınacı, E., Çakar, E., Bayrak, S., Özakay, A., Aren, A., & Sarı, S. (2016). Diagnostic value of basic laboratory parameters for simple and perforated acute appendicitis: an analysis of 3392 cases. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES, 22(2), 155–162. <https://doi.org/10.5505/tjtes.2016.54388>
- Al Kamarany, M. , & Ghouth, A. S. B. . (2024). The Ice Berge of Cholera in Hodeidah , Yemen : The Contact Exposure. *Studies in Medical and Health Sciences*, 1(1), 32–35. <https://doi.org/10.48185/smhs.v1i1.1169>
- AlDobaie , S. , AlKrnay , A. , Ali, Z. , Hudish , N. , Almahi , F. , Alburai , A. , Badr, H. , AlHakimi , H. , AlQubaty , T. , Alaskari , F. , & Al Kamarany , M. . (2025). Density of Dengue Vector in Hodeidah, Yemen 2017. *Studies in Medical and Health Sciences*, 2(1), 29–40. <https://doi.org/10.48185/smhs.v2i1.1707>
- Kahramanca, S., Ozgehan, G., Seker, D., Gökce, E. I., Seker, G., Tunç, G., Küçükpınar, T., & Kargıcı, H. (2014). Neutrophil-to-lymphocyte ratio as a predictor of acute appendicitis. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES, 20(1), 19–22. <https://doi.org/10.5505/tjtes.2014.20688>
- Aydın, O. U., Soylu, L., Dandin, O., Uysal Aydın, E., & Karademir, S. (2016). Laboratory in complicated appendicitis prediction and predictive value of monitoring. *Bratislavské lekárske listy*, 117(12), 697–701. <https://doi.org/10.4149/BLL.2016.132>
- Aydın, Ö. F., & Tatlıparmak, A. C. (2025). Diagnostic accuracy of systemic immune-inflammation index for acute appendicitis in the geriatric population. *European journal of medical research*, 30(1), 63. <https://doi.org/10.1186/s40001-025-02336-6>
- Torun, M., Subaşı, İ. E., Özbay, D. K., Özbay, M. A., & Özdemir, H. (2025). Utilizing non-invasive biomarkers for early and accurate differentiation of uncomplicated and complicated acute appendicitis: a retrospective cohort analysis. *Scientific reports*, 15(1), 6177. <https://doi.org/10.1038/s41598-025-90591-2>
- Antić, J., Jokić, R., Bukarica, S., Lukić, I., Dobrijević, D., Rakić, G., Pajić, M., Trajković, V., & Milenković, M. (2021). Predictive Value of Red Blood Cell Distribution Width, Mean Platelet Volume and Platelet Distribution Width in Children with Acute Appendicitis. *Children (Basel, Switzerland)*, 8(11), 1041. <https://doi.org/10.3390/children8111041>
- Şimşek, O., Şirolu, S., Özkan Irmak, Y., Hamid, R., Ergun, S., Kepil, N., & Tutar, O. (2024). Comparative study of imaging features in uncomplicated and complicated acute appendicitis. Komplike ve komplike olmayan akut apandisitini görüntüleme özelliklerinin karşılaştırmalı incelemesi. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES, 30(10), 722–728. <https://doi.org/10.14744/tjtes.2024.50363>
- Avanesov, M., Wiese, N. J., Karul, M., Guerreiro, H., Keller, S., Busch, P., Jacobsen, F., Adam, G., & Yamamura, J. (2018). Diagnostic prediction of complicated appendicitis by combined clinical and radiological appendicitis severity index (APSI). *European radiology*, 28(9), 3601–3610. <https://doi.org/10.1007/s00330-018-5339-9>
- Kessler, N., Cyteval, C., Gallix, B., Lesnik, A., Blayac, P. M., Pujol, J., Bruel, J. M., & Taourel, P. (2004). Appendicitis: evaluation of sensitivity, specificity, and predictive values of US, Doppler US, and laboratory findings. *Radiology*, 230(2), 472–478. <https://doi.org/10.1148/radiol.2302021520>
- Berhuni, M. S., Yönder, H., Elkan, H., Koyuncu, M. H., Özgül, F., Tatlı, F., Özgönül, A., & Üzünköy, A. (2024). Diagnostic Value of

- Systemic Immune Inflammation Index in Identifying Complicated Acute Appendicitis Cases. *Cureus*, 16(11), e73046. <https://doi.org/10.7759/cureus.73046>
- 27) Erkent, M., Karakaya, E., & Yücebaş, S. C. (2022). A new approach to the management of acute appendicitis: Decision tree method. *The American journal of emergency medicine*, 54, 142–146. <https://doi.org/10.1016/j.ajem.2022.01.034>
 - 28) Uludağ, S. S., Akıncı, O., Güreş, N., Tunç, E., Erginöz, E., Şanlı, A. N., Zengin, A. K., & Özçelik, M. F. (2022). Effectiveness of pre-operative routine blood tests in predicting complicated acute appendicitis. Komplike akut apandisitisi öngörmede ameliyat öncesi rutin kan testlerinin etkinliği. *Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES*, 28(11), 1590–1596. <https://doi.org/10.14744/tjtes.2021.13472>
 - 29) Kaminskas, A. A., Lukšaitė-Lukštė, R., Jasiūnas, E., Samuilis, A., Augustinavičius, V., Kryžauskas, M., Strupas, K., & Poškus, T. (2021). The Dynamics of Inflammatory Markers in Patients with Suspected Acute Appendicitis. *Medicina (Kaunas, Lithuania)*, 57(12), 1384. <https://doi.org/10.3390/medicina57121384>
 - 30) Atema, J. J., Gans, S. L., Beenen, L. F., Toorenvliet, B. R., Laurell, H., Stoker, J., & Boermeester, M. A. (2015). Accuracy of White Blood Cell Count and C-reactive Protein Levels Related to Duration of Symptoms in Patients Suspected of Acute Appendicitis. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine*, 22(9), 1015–1024. <https://doi.org/10.1111/acem.12746>
 - 31) Leeuwenburgh, M. M., Stockmann, H. B., Bouma, W. H., Houdijk, A. P., Verhagen, M. F., Vrouenraets, B., Cobben, L. P., Bossuyt, P. M., Stoker, J., Boermeester, M. A., & OPTIMAP Study Group (2014). A simple clinical decision rule to rule out appendicitis in patients with nondiagnostic ultrasound results. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine*, 21(5), 488–496. <https://doi.org/10.1111/acem.12374>