## Comparative Study between Alvarado Scoring System and Ripasa Scoring System in Acute Appendicitis

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### Abstract

**Background & Objectives -**Acute appendicitis is one of the most common causes of acute abdominal pain requiring emergency surgical intervention. Despite advancements in imaging techniques, clinical scoring systems such as the Alvarado Scoring System and the RIPASA Scoring System remain essential diagnostic tools, particularly in resource-limited settings. This study aims to compare the diagnostic value, sensitivity, and specificity of the Alvarado and RIPASA Scoring Systems in patients presenting with right iliac fossa pain suspected of acute appendicitis.

**Materials & Methods**: This hospital-based observational study was conducted at Gulbarga Institute of Medical Sciences over 18 months (May 2023 – October 2024). A total of 170 patients presenting with right iliac fossa pain were included. Patients were assessed using both the Alvarado and RIPASA scoring systems, and their scores were compared with histopathological confirmation of appendicitis. Statistical analysis was performed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) to evaluate the diagnostic accuracy of each scoring system.

**Results**: The study revealed that the RIPASA Score demonstrated higher sensitivity (94%) compared to the Alvarado Score (72.8%), indicating better diagnostic accuracy. The specificity of the RIPASA Score was 88%, whereas the Alvarado Score had a specificity of 100%, suggesting that Alvarado is more effective in

ruling out non-appendicitis cases. The positive predictive value (PPV) for both scores was 100%, meaning that a high score reliably indicated appendicitis, whereas the negative predictive value (NPV) was higher for RIPASA (90.7%) than for Alvarado (70.5%), indicating that RIPASA is more effective in identifying true-negative cases.

**Conclusion**: This study confirms that the RIPASA Score is superior to the Alvarado Score in diagnosing acute appendicitis, particularly in Asian populations, due to its higher sensitivity and diagnostic accuracy. However, the Alvarado Score remains a valuable tool, particularly for ruling out non-appendicitis cases.

**Keywords:** Acute Appendicitis, Alvarado Score, RIPASA Score, Right Iliac Fossa Pain, Emergency Surgery.

**Introduction**

Acute appendicitis is one of the most frequent causes of acute abdominal pain requiring emergency surgical intervention. It has an estimated lifetime prevalence of 7–8% and remains a significant contributor to morbidity, especially in cases of delayed or misdiagnosis [1,2]. Despite advancements in diagnostic imaging, clinical scoring systems continue to play a crucial role in early detection, particularly in resource-limited settings where imaging facilities may not be readily available [3]. Among these, the Alvarado Scoring System and the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) Scoring System are two widely used predictive models aimed at improving the clinical diagnosis of acute appendicitis [4].

Alvarado Scoring System - The Alvarado Score is a clinical decision-making tool designed to assess the likelihood of acute appendicitis. It was developed by Alfredo Alvarado in 1986 and published in the Annals of Emergency Medicine [1]. The scoring system is based on a combination of symptoms, clinical signs, and laboratory findings, aiming to assist clinicians in making more accurate diagnoses, especially in emergency settings.

Components of the Alvarado Score - The score consists of eight clinical parameters, each assigned a specific value based on its diagnostic significance. The total possible score is 10.(Table 1)

Table 1: Alvarado Scoring System

| Criteria | Score |
|---|---|
| **Symptoms** | |
| Migration of pain to RLQ | 1 |
| Anorexia | 1 |
| Nausea or vomiting | 1 |
| **Signs** | |
| Tenderness in RLQ | 2 |
| Rebound tenderness | 1 |
| Elevated temperature (≥37.3°C) | 1 |
| **Laboratory Findings** | |
| Leukocytosis (>10,000/mm³) | 2 |
| Shift to left (neutrophilia) | 1 |
| **Total Possible Score** | **10** |

The higher the score, the greater the likelihood of acute appendicitis.

Interpretation of Alvarado Score -

- Score 1-4 → Low risk: Appendicitis is unlikely; conservative management advised.
- Score 5-6 → Equivocal: Further investigations such as ultrasound or CT scan are recommended.
- Score 7-8 → Probable appendicitis: Strong indication for surgical evaluation.
- Score 9-10 → Definitive appendicitis: Immediate surgical intervention is suggested.

Advantages of the Alvarado Score

- Simple and Easy to Use – Only requires basic clinical assessment and blood tests.
- Time-Saving – Can be applied quickly in emergency settings.
- Widely Validated – Extensively studied and implemented in many countries [2].
- Reduces Unnecessary Surgeries – Helps in avoiding negative appendectomies (removing a normal appendix).

Limitations of the Alvarado Score

- Lower sensitivity in females – Symptoms of appendicitis can overlap with gynecological conditions like ovarian cyst rupture or pelvic inflammatory disease.
- Limited applicability to elderly patients – Older patients may have atypical presentations [3].
- Lower accuracy in children – Children under 5 years may have less specific symptoms.

Clinical Significance - Despite its limitations, the Alvarado Score remains one of the most commonly used clinical tools for assessing acute appendicitis, particularly in resource-limited settings where advanced imaging (like CT scans) is unavailable.

RIPASA Scoring System - The RIPASA Score (Raja Isteri Pengiran Anak Saleha Appendicitis Score) was developed in Brunei in 2010 by Chong et al. aiming to improve diagnostic accuracy in Asian and Middle Eastern populations [4]. Studies showed that the Alvarado Score was less effective in these populations due to differences in genetic, dietary, and healthcare factors.

Components of the RIPASA Score - Unlike the Alvarado Score, which consists of 8 parameters, the RIPASA Score includes 14 parameters, providing a more detailed assessment. (Table 2)

Table 2: RIPASA Scoring System

| Criteria | Score |
|---|---|
| Anorexia | 1 |
| Nausea and vomiting | 1 |
| Duration of symptoms < 48 hours | 1 |
| **Clinical Signs** | |
| RLQ tenderness | 1 |
| Rebound tenderness | 1 |
| Raised temperature (>37°C) | 0.5 |
| **Laboratory Findings** | |

| | |
|---|---|
| Leukocytosis (>10,000/mm³) | 1 |
| Neutrophilia | 1 |
| **Other Factors** | |
| Negative urinalysis | 1 |
| Foreign national status | 1 |
| **Total Possible Score** | **17.5** |

Interpretation of RIPASA Score

- Score <5 → Unlikely appendicitis.

- Score 5-7.5 → Possible appendicitis; further observation or imaging needed.

- Score 7.5-12 → Probable appendicitis; early surgical intervention advised.

- Score >12 → Highly probable appendicitis; urgent surgery recommended.

Advantages of the RIPASA Score

- Higher Sensitivity (98%) – More effective in diagnosing appendicitis than Alvarado (68%) [5].

- More Comprehensive – Covers 14 parameters, including age and gender.

- Better for Asian and Middle Eastern Populations – More suited to local patient characteristics.

Limitations of the RIPASA Score

- More Complex than Alvarado – Requires more parameters, which may delay diagnosis in emergency settings.

- Potential Overdiagnosis – High sensitivity may result in more unnecessary surgeries.

**Comparison of Alvarado and RIPASA Scores**

Both Alvarado and RIPASA scores are valuable tools for diagnosing acute appendicitis. While the Alvarado Score is simpler and widely used, the RIPASA Score offers greater accuracy in specific populations. The choice of scoring system should depend on patient demographics, hospital resources, and clinical expertise.

In Western populations, Alvarado remains the preferred tool, while in Asian and Middle Eastern populations, RIPASA is more effective.

Despite being a common surgical emergency, diagnosing acute appendicitis remains challenging, particularly because its clinical presentation varies across different individuals. Patients may exhibit classic symptoms, including right iliac fossa pain, nausea, vomiting, and fever, but atypical presentations—such as diffuse abdominal discomfort, urinary symptoms, or altered bowel habits—can lead to misdiagnosis or delays in treatment[6].

Additionally, acute appendicitis frequently mimics other abdominal pathologies, making differentiation difficult. Conditions such as gastroenteritis, pelvic inflammatory disease (PID), urinary tract infections (UTIs), right ureteric colic, ovarian cyst rupture, and mesenteric lymphadenitis share overlapping symptoms, particularly in females and pediatric populations[7]. In elderly patients, symptom onset may be subtle, leading to delayed recognition and higher complication rates[8].

**Limitations of Traditional Diagnostic Approaches**

The gold standard for confirming appendicitis remains histopathological examination following appendectomy, which provides definitive proof of acute inflammation, necrosis, or perforation[9]. However, relying solely on surgical intervention for diagnosis has significant drawbacks. The negative appendectomy rate (NAR)—defined as the proportion of patients undergoing surgery

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for suspected appendicitis who ultimately do not have histopathologically confirmed appendicitis—is reported to range between 20-40%[10]. A high NAR not only increases unnecessary surgical risks (such as anesthesia complications, wound infections, and prolonged hospital stays) but also adds to healthcare costs[11].

To reduce diagnostic errors and improve decision-making, clinicians increasingly rely on scoring systems and imaging techniques to assess suspected appendicitis cases before proceeding with surgery. Ultrasound (USG) and computed tomography (CT) scans are often used to confirm diagnosis, but they may not always be readily available, especially in resource-limited settings[12]. This underscores the need for cost-effective, reliable, and widely applicable clinical diagnostic tools, such as the Alvarado and RIPASA scoring systems, which provide a structured approach to evaluating appendicitis likelihood based on patient symptoms, signs, and laboratory findings[13].

## Materials and Methods

### Source of Data

The study will include patients presenting with right iliac fossa (RIF) pain at the Outpatient Department (OPD) and Casualty of Gulbarga Institute of Medical Sciences.

### Method of Data Collection

**Type of study:** Hospital-based observational study

**Study Duration:** 18 months (May 2023 – October 2024)

**Sample Size:** 170 patients

The sample size calculation was based on sensitivity and specificity from a previous study by Nurullah Damburaci et al., which reported Alvarado score sensitivity at 88% and specificity at 69%. The prevalence of acute appendicitis in the institute over the past year was estimated at 30%. An absolute error of 10% was considered for the calculation.

Using the standard formula:

$$n_{Se} = \frac{Z^2_{\frac{\alpha}{2}} \widehat{Se}(1-\widehat{Se})}{d^2 \times Prev}$$

$$n_{Sp} = \frac{Z^2_{\frac{\alpha}{2}} \widehat{Sp}(1-\widehat{Sp})}{d^2 \times (1-Prev)}$$

- N se (sample size based on sensitivity) = 136
- N sp (sample size based on specificity) = 118

### Study Centre

Gulbarga Institute of Medical Sciences

### Inclusion Criteria

- Patients with right iliac fossa pain.
- Age group: 14 to 60 years.

### Exclusion Criteria

- Pregnant and lactating women.
- Pediatric patients (below 14 years).
- Geriatric patients (above 60 years).
- Patients unwilling to participate in the study.
- Patients with conditions other than acute appendicitis (e.g., right ureteric calculi, appendicular mass, appendicular abscess, etc.).

### Methodology

- A total of 170 patients will be included in the study.
- Detailed history and clinical examination will be conducted upon inclusion.
- Informed consent will be obtained from all participants.
- Routine laboratory investigations will be performed, including urine analysis.
- Scoring will be done based on signs, symptoms, and routine investigations.
- The provisional diagnosis of acute appendicitis will be confirmed by histopathology.

The Alvarado and RIPASA scores will be compared, and the positive predictive value, sensitivity, and specificity of both scoring systems will be assessed.

*Statistical analysis:* The data collected will be recorded and entered in the MS Excel master sheet. Data will be tabulated and analyzed using software Statistical Package for Social Sciences (SPSS) version 22. Categorical data will be presented as numbers and percentages (%). Qualitative variables will be analyzed using Pearson's chi-square test and Fisher exact tests. Quantitative variables will be presented using mean and standard deviation and analyzed using Student T test and Mann–Whitney U test wherever applicable. Sensitivity and specificity of the tests will be analyzed using receiver operating characteristic curve (ROC). A p value of <0.05 will be considered as statistically significant.

**Results**

The age distribution data reveals that the majority of individuals fall within the younger age groups. Specifically, both the 14-20 years and 21-30 years age categories have the highest frequency, each accounting for 34.1% of the total population. This suggests that more than two-thirds (68.2%) of the population belongs to the adolescent and young adult groups. The 31-40 years age group follows, representing 20.6%, indicating a gradual decline in frequency as age increases. The 41-50 years category comprises 6.5%, and the lowest representation is observed in the 51-60 years age group, making up only 4.7% of the total population. [Table 3 and Fig 1]

Table 3: Distribution of age among the study participants (N=170)

| Sl.no | Age | Frequency | Percentage |
|---|---|---|---|
| 1 | 14-20 | 58 | 34.1 |
| 2 | 21-30 | 58 | 34.1 |
| 3 | 31-40 | 35 | 20.6 |
| 4 | 41-50 | 11 | 6.5 |
| 5 | 51-60 | 8 | 4.7 |

Figure 1: Distribution of age among the study participants (N=170)
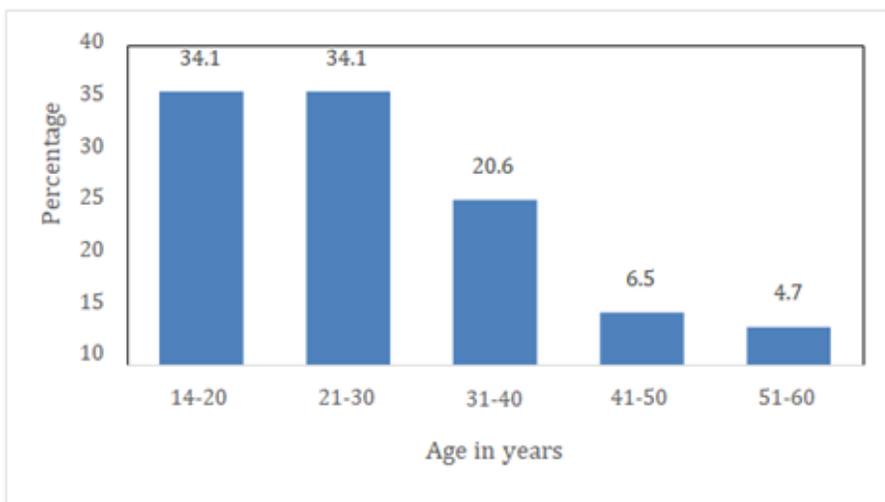
The gender distribution data indicates a higher representation of males compared to females in the study population. Males constitute 62.9% of the total participants, while females make up 37.1%. [Table 4 and Fig 2]

Table 4: Distribution of gender among the study participants (N=170)

| Sl.no | Gender | Frequency | Percentage |
|-------|--------|-----------|------------|
| 1 | Female | 63 | 37.1 |
| 2 | Male | 107 | 62.9 |

Figure 2: Distribution of gender among the study participants (N=170)
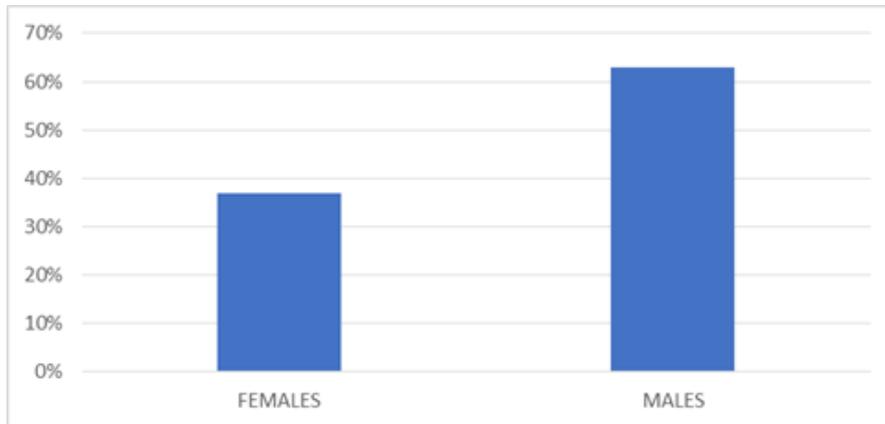


The Alvarado scoring system data highlights the frequency and percentage of various clinical parameters used in the diagnosis of acute appendicitis. The most commonly observed symptom is right iliac fossa (RIF) tenderness, present in 90.6% of cases, followed by migratory pain, reported in 84.1% of individuals. Other significant symptoms include nausea/vomiting (62.4%) and anorexia (54.1%), which are commonly associated with gastrointestinal disturbances in appendicitis. Rebound tenderness was noted in 35.9% of cases, which may indicate peritoneal irritation. Among systemic signs, leukocytosis was observed in 30%, while a shift to the left (indicating an increase in immature white blood cells) was present in 27.1% of cases. Elevated body temperature was the least common feature, seen in only 9.4% of cases, suggesting that fever may not always be a reliable diagnostic marker for appendicitis. [Table 5]

Table 5: Distribution of Alvarado scoring system among the study participants (N=170)

| Sl.no | Alvarado scoring system | Frequency | Percentage |
|-------|-------------------------|-----------|------------|
| 1 | Migratory pain | 143 | 84.1 |
| 2 | Anorexia | 92 | 54.1 |
| 3 | Nausea/Vomiting | 106 | 62.4 |
| 4 | RIF tenderness | 154 | 90.6 |
| 5 | Rebound tenderness | 61 | 35.9 |
| 6 | Elevated body temperature | 16 | 9.4 |
| 7 | Leukocytosis | 51 | 30 |
| 8 | Shift to Left | 46 | 27.1 |

The Alvarado scoring system classification data categorizes patients based on the likelihood of acute appendicitis. The largest proportion of cases (39.4%) falls under the NL (Normal/Non-appendicitis) category, indicating that nearly 40% of the evaluated individuals did not meet the clinical criteria for appendicitis. Among those suspected of having appendicitis, 35.3% were classified as compatible with acute appendicitis, suggesting a moderate probability of the condition. Meanwhile, 17.1% were categorized as probable acute appendicitis, indicating a higher likelihood requiring close monitoring or further diagnostic evaluation. The smallest proportion (8.2%) was deemed very probable acute appendicitis, suggesting a strong clinical suspicion that may warrant urgent surgical intervention. [Table 6 and Fig 3].

Table 6: Distribution of Alvarado scoring system classification among the study participants (N=170)

| Sl.no | Alvarado scoring system classification | Frequency | Percentage |
|---|---|---|---|
| 1 | Compatible with Acute Appendicitis | 60 | 35.3 |
| 2 | Probable Acute Appendicitis | 29 | 17.1 |
| 3 | Very Probable Acute Appendicitis | 14 | 8.2 |
| 4 | NL (Not likely) (Non-Appendicitis) | 67 | 39.4 |

Figure 3: Distribution of Alvarado scoring system classification among the study participants (N=170)
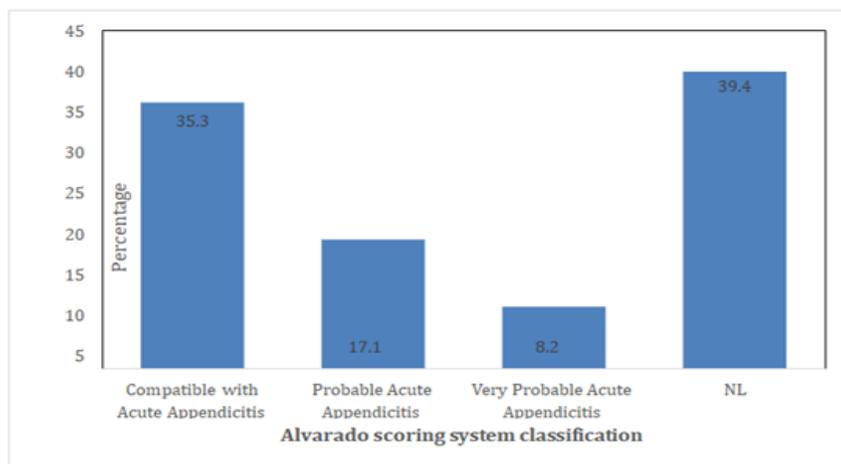


In this study, the mean age of patients was 26 years (±12), ranging from 11 to 70 years. Among the total cases, 67 patients were found to have a normal appendix upon histopathological examination. Of these, 40 were females and 27 were males, indicating a higher incidence of negative appendectomies in females. The negative appendectomy rate—defined as the proportion of surgeries where the removed appendix was found to be normal—was 39.4%, highlighting the diagnostic challenges in accurately identifying appendicitis, especially in certain patient groups. [Table 7].

Table 7: Distribution of HPR confirmation (N=170)

| Parameter | Value |
|---|---|
| Mean Age | 26 ± 12 years (Range: 11–70) |
| Total Patients with Normal Appendix | 67 patients |
| Gender Distribution (Normal Appendix) | 40 females, 27 males |
| Negative Appendectomy Rate | 39.4% |

The RIPASA scoring system data provides an overview of clinical and laboratory parameters used for diagnosing acute appendicitis. The majority of patients (89.4%) were younger than 40 years, with 61.8% being male and 38.2% female, reflecting a male predominance in the study population. Among clinical symptoms, right iliac fossa (RIF) pain was present in 62.4% of cases, while migration of pain to the RIF, a key characteristic of appendicitis, was reported in 83.5% of patients. Nausea or vomiting was experienced by 62.4%, and anorexia was observed in 52.4% of individuals. Regarding symptom duration, most cases (70%) had symptoms lasting more than 48 hours, while only 1.2% had symptoms for less than 48 hours, suggesting that many patients sought medical attention after prolonged symptoms. On clinical examination, RIF tenderness was a dominant finding, present in 88.8% of cases, while RIF rebound tenderness was noted in 36.5%. More severe signs, such as RIF guarding (2.9%) and Rovsing's sign (3.5%), were relatively uncommon, indicating that peritoneal irritation was less frequent. Systemic signs such as fever were seen in only 7.6%, while leukocytosis (elevated WBC count) was present in 29.4%, suggesting that laboratory markers may not always be conclusive in appendicitis. Negative urinalysis, an indicator to rule out urinary tract involvement, was seen in only 2.9% of cases [Table 8].

Table 8: Distribution of RIPASA scoring system among the study participants (N=170)

| Sl.no | RIPASA scoring system | Frequency | Percentage |
|---|---|---|---|
| 1 | **Age** | | |
| | <40 | 152 | 89.4 |
| | >40 | 18 | 10.6 |
| 2 | **Gender** | | |
| | Male | 105 | 61.8 |
| | Female | 65 | 38.2 |
| 3 | **RIF pain** | 106 | 62.4 |
| 4 | **Migration to RIF pain** | 142 | 83.5 |
| 5 | **Nausea/Vomiting** | 106 | 62.4 |
| 6 | **Anorexia** | 89 | 52.4 |
| 7 | **Duration of symptoms** | | |
| | <48 hrs | 2 | 1.2 |
| | >48 hrs | 119 | 70 |
| 8 | RIF tenderness | 151 | 88.8 |
| 9 | RIF Rebound tenderness | 62 | 36.5 |
| 10 | RIF guarding | 5 | 2.9 |
| 11 | Rovsing's sign | 6 | 3.5 |
| 12 | Fever | 13 | 7.6 |

| 13 | Raised WBC count | 50 | 29.4 |
| 14 | Negative urinalysis | 5 | 2.9 |

The distribution of the RIPASA scoring system classification among the study participants (N=170) indicates that the majority of cases fell into the low probability category. Specifically, 74.7% of participants were classified as having a low probability of acute appendicitis. In contrast, 25.3% of participants were classified as having a high probability of acute appendicitis [Table 9 and Fig 4] .

Table 9: Distribution of study participants score as per RIPASA scoring system participants (N=170)

| Sl.no | RIPASA scoring system classification | Frequency | Percentage |
| --- | --- | --- | --- |
| 1 | Low Probability | 127 | 74.7 |
| 2 | High Probability | 43 | 25.3 |

Figure 4: Distribution of RIPASA scoring system classification among the study participants (N=170)
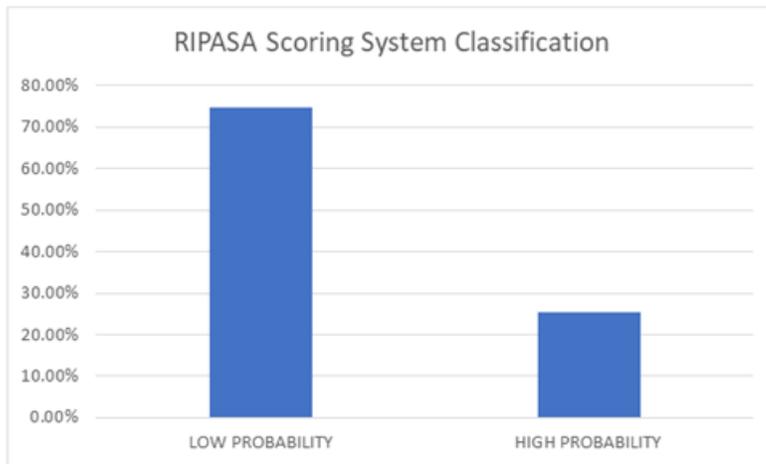


The distribution of procedures among the study participants (N=170) indicates that open appendectomy (OA) was the more commonly performed surgical approach, accounting for 66.5% of cases. In contrast, laparoscopic appendectomy (LA) was performed in 33.5% of patients [Table 10 and Fig 5].

Table 10: Distribution of procedure among the study participants (N=170)

| Sl.no | Procedure | Frequency | Percentage |
| --- | --- | --- | --- |
| 1 | LA (Laparoscopic appendicectomy) | 57 | 33.5 |
| 2 | OA(Open appendicectomy) | 113 | 66.5 |

Figure 5: Distribution of procedure among the study participants (N=170)
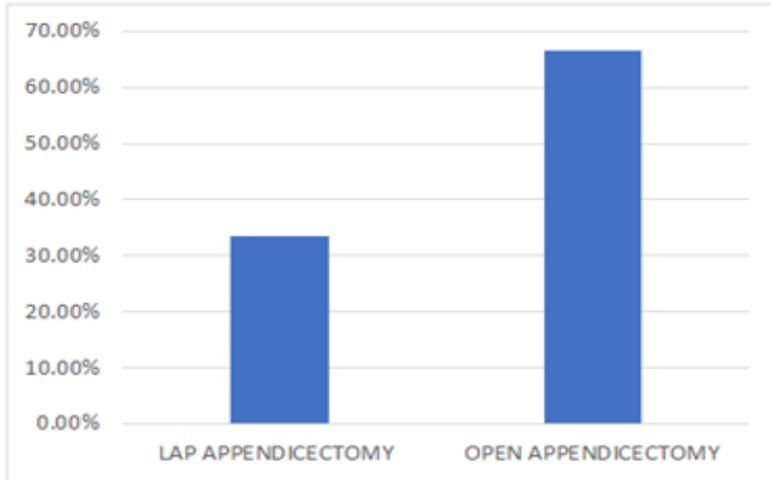


The Alvarado scoring system exhibited high specificity (100%) and a perfect positive predictive value (PPV of 100%), meaning that a score above 5 reliably indicated appendicitis. However, the sensitivity of 72.82% and negative predictive value (NPV of 70.53%) suggest that some cases of appendicitis were missed when the score was below 5 [Table 11 and 12].

Table 11: Diagnostic accuracy of Alvarado scoring system among the study participants (N=170)

| Sl.no | Alvarado scoring system | Appendicitis present | Appendicitis absent |
|---|---|---|---|
| 1 | >5 | 75 | 0 |
| 2 | <5 | 28 | 67 |

Table 12: Alvarado scoring system statistics

| Statistic | Value | 95% CI |
|---|---|---|
| Sensitivity | 72.82% | 63.16% to 81.12% |
| Specificity | 100.00% | 94.64% to 100.00% |
| Disease prevalence | 60.59% | 52.82% to 67.98% |
| Positive Predictive Value | 100.00% | 95.20% to 100.00% |
| Negative Predictive Value | 70.53% | 63.56% to 76.65% |
| Accuracy | 83.53% | 77.08% to 88.77% |

The RIPASA scoring system demonstrated excellent specificity (100%) and positive predictive value (100%), meaning that a score above 7.5 reliably confirmed appendicitis. Additionally, its negative predictive value (90.71%) was quite high, indicating that most patients with a score below 7.5 were correctly classified as not having appendicitis. However, the sensitivity (69.77%) was moderate, suggesting that around 30% of true appendicitis cases were missed when relying solely on this score. Despite this, the high accuracy (92.35%) supports its reliability as a valuable diagnostic tool [Table 13 and 14].

Table 13: Diagnostic accuracy of RIPASA scoring system among the study participants (N=170)

| Sl no | RIPASA scoring system | Appendicitis present | Appendicitis absent |
|-------|----------------------|---------------------|---------------------|
| 1 | >7.5 | 30 | 0 |
| 2 | <7.5 | 13 | 127 |

Table 14: RIPASA Scoring System Statistics

| Statistic | Value | 95% CI |
|-----------|-------|--------|
| Sensitivity | 69.77% | 53.87% to 82.82% |
| Specificity | 100.00% | 97.14% to 100.00% |
| Disease prevalence | 25.29% | 18.95% to 32.52% |
| Positive Predictive Value | 100.00% | 88.43% to 100.00% |
| Negative Predictive Value | 90.71% | 86.12% to 93.90% |
| Accuracy | 92.35% | 87.28% to 95.87% |

## Discussion

**Age Distribution:** In our study, the majority of participants were younger, with 68.2% in the 14-30 years age range. This is comparable to the findings of Ud Din et al., where 71.2% of the patients were younger than 40 years. Similarly, Jaiswal et al. reported that 70% of their study population was under 40 years, reinforcing the predominance of younger individuals affected by acute appendicitis. However, in contrast, Davut Tekyol et al. studied an older population with a mean age of 71.2 ± 5.9 years, indicating that their focus was likely on appendicitis in the elderly, a group known to present with atypical symptoms and a higher risk of complications.

**Gender Distribution:** Our study showed a male predominance (62.9%), which aligns closely with Ud Din et al. (65.8% males) and Nanjundaiah et al. (61.6% males). However, Jaiswal et al. reported a more balanced gender distribution, with 48% males and 52% females, suggesting a more even incidence of appendicitis between the sexes in their cohort. Davut Tekyol et al. had a lower male representation (46.5%), potentially reflecting a different demographic composition or healthcare-seeking behavior among older adults.

**Duration of Symptoms:** In our study, the majority of patients had symptoms lasting more than 48 hours (70%), whereas Ud Din et al. reported that 75.8% of patients presented with symptoms lasting less than 48 hours. This discrepancy may suggest variations in healthcare accessibility, patient delay in seeking medical attention, or differences in the clinical severity of appendicitis across populations.

**Alvarado Score Performance:** Our study showed that an Alvarado score >5 had a sensitivity of 72.82%, a specificity of 100%, and an accuracy of 83.53%. These findings are similar to Ud Din et al., where the Alvarado score had a sensitivity of 71.1% and specificity of 75.8%, though their accuracy was slightly lower (71.46%). Nanjundaiah et al. found an even lower sensitivity (58.9%) and specificity (85.7%) for the Alvarado score, suggesting that it may be less effective in their population. Davut Tekyol et al., using a cutoff of Alvarado >4, reported a sensitivity of 69.2% and specificity of 85.7%, which is in line with our results, reinforcing the notion that Alvarado is a useful but

imperfect tool, particularly in populations with atypical appendicitis presentations.

In our study, the RIPASA score (>7.5) demonstrated a sensitivity of 69.77% and specificity of 100%, with an overall accuracy of 92.35%, making it more accurate than the Alvarado score. This aligns with Ud Din et al., who found a higher sensitivity (95.8%) but a slightly lower specificity (87.9%), suggesting that RIPASA may be more effective in their population but carries a higher false-positive rate. Similarly, Nanjundaiah et al. reported a RIPASA sensitivity of 96.2% and specificity of 90.5%, with a higher PPV (98.9%) and NPV (73.1%) than our study. Davut Tekyol et al., using a slightly higher cutoff (>8), found a sensitivity of 78.5% and specificity of 85.7%, indicating that the RIPASA score remains highly effective across different populations, particularly in Asian and Middle Eastern cohorts.

## Comparison of Scoring System Accuracy

In terms of overall diagnostic accuracy, our study found that RIPASA (92.35%) was significantly superior to Alvarado (83.53%), a trend also observed in Ud Din et al. (95.12% vs. 71.46%) and Nanjundaiah et al. (ROC-AUC of 0.982 for RIPASA vs. 0.849 for Alvarado, with a significant 13.4% difference). Davut Tekyol et al. also found that the RIPASA score outperformed Alvarado, though their difference was not statistically significant (p=0.09). These findings consistently suggest that RIPASA is a more accurate tool for diagnosing appendicitis, especially in populations where Alvarado may underperform.

## ROC Analysis and Statistical Significance

In Nanjundaiah et al., the ROC curve analysis showed that RIPASA (AUC=0.982) was significantly better than Alvarado (AUC=0.849, p<0.001), with 13.4% of cases being misdiagnosed by Alvarado compared to RIPASA.

Our study's findings support this trend, with RIPASA showing superior accuracy and predictive values compared to Alvarado. Davut Tekyol et al., however, found no statistically significant difference between the two scoring systems (p=0.09), though RIPASA had a slightly higher YJI value, indicating better discriminatory power.

Acute appendicitis is a prevalent surgical emergency requiring prompt diagnosis to prevent complications such as perforation and peritonitis. Over the years, various clinical scoring systems have been developed to improve diagnostic accuracy, reducing unnecessary surgeries and complications. Among these, the Alvarado Score and RIPASA Score are widely used. While the Alvarado Score, introduced in 1986, has been the traditional method of assessment, the RIPASA Score, developed more recently, is considered to be more effective, particularly in Asian populations. Several studies have compared these two scoring systems, evaluating their diagnostic efficacy based on sensitivity, specificity, and predictive values.

A prospective study conducted by Nanjundaiah et al. (2014) assessed 206 patients presenting with right iliac fossa pain and applied both scoring systems. The results demonstrated that the RIPASA Score had a higher sensitivity (96.2%) and specificity (90.5%) compared to the Alvarado Score (58.9% sensitivity and 85.7% specificity). These findings suggest that RIPASA is more reliable in identifying true positive cases, thereby reducing the risk of misdiagnosis and unnecessary surgeries.

Similarly, Sharma et al. (2014) conducted a study on 167 patients undergoing emergency appendicectomy and found that the RIPASA Score exhibited superior diagnostic accuracy. This finding aligns with research by

Mumtaz et al. (2022), who conducted a prospective cohort study on 171 patients in KRL Hospital and found that the RIPASA Score was more effective in detecting acute appendicitis, particularly in Asian populations. This can be attributed to the fact that RIPASA includes additional parameters such as gender, nationality, and additional clinical symptoms, making it more comprehensive than the Alvarado Score.

On the other hand, a study by Chisthi et al. (2020), which included 107 patients, compared the Modified Alvarado Score, Appendicitis Inflammatory Response (AIRS) Score, and RIPASA Score. Their findings indicated that while RIPASA had higher sensitivity, the Alvarado Score showed moderate specificity. This suggests that while RIPASA is more effective in ruling in cases, the Alvarado Score may still have value in ruling out non-appendicitis cases.

Furthermore, Walia et al. (2022) conducted a prospective study on 60 patients in Patiala, using hematological and biochemical investigations to calculate sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) for Alvarado, RIPASA, and AIRS Scores. Their results reinforced that RIPASA outperformed Alvarado in diagnostic accuracy, particularly in patients with atypical presentations.

In contrast, Damburacı and Sevinç (2015) analyzed 100 surgically treated appendicitis cases and found that the optimal Alvarado Score threshold had a sensitivity of 88% and specificity of 69%, while RIPASA had a sensitivity of 94% and specificity of 88%. These results further confirm the superior performance of RIPASA in diagnosing acute appendicitis.

Sanjive JG and Ramaiah RH conducted this study, published in the International Surgery Journal in 2019. They evaluated the diagnostic performance of both scoring systems in patients presenting with right iliac fossa pain. The RIPASA score demonstrated higher sensitivity and specificity compared to the Alvarado score. The authors suggested that the RIPASA scoring system is superior in diagnosing acute appendicitis in Asian populations and can reduce unnecessary radiological investigations

## Conclusion

Comparing our findings with the previous studies conducted, it is evident that the RIPASA score consistently outperforms the Alvarado score in sensitivity, specificity, and overall accuracy. Our study, along with Ud Din et al. and Nanjundaiah et al., confirms that RIPASA is particularly effective in accurately diagnosing appendicitis, reducing misdiagnoses, and minimizing unnecessary surgeries. The Alvarado score remains a useful tool but has lower sensitivity, making it less reliable in borderline cases. The negative appendectomy rates and postoperative complications remain low across studies, emphasizing the importance of combining clinical scoring with imaging for optimal patient outcomes.

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