e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(6); 1470-1478

Original Research Article

# Evaluation of RIPASA Score Compared to Modified Alvarado Score in the Diagnosis of Acute Appendicitis

**Saumya Sinha[1,2], Shakeb Ahmed[3], M. Arif Ansari[3*]**

[1]Senior Resident, General Surgery IGIMS, Patna, Bihar, India
[2]Junior Resident Department of General Surgery, Katihar Medical College, Al-Karim University, Katihar, Bihar, India
[3]Professor, General Surgery, Katihar Medical College, Al-Karim University, Katihar, Bihar, India

**Received: 23-04-2023 / Revised: 27-05-2023 / Accepted: 20-06-2023**
**Corresponding author: Dr. M. Arif Ansari**
**Conflict of interest: Nil**

**Abstract:**

**Objective**: The diagnosis of acute appendicitis is still a challenge because it is a common yet difficult surgical illness. Since there are numerous clinical mimics and the diagnosis is mostly based on clinical criteria, clinical scoring systems have developed to help identify the correct diagnosis. This study aims to evaluate the diagnosis precision in acute appendicitis with a lower rate of negative appendectomy; by comparing the RIPASA score with the modified Alvarado score on patients undergoing emergency appendectomy.

**Material and methods**: Over a two-and-a-half-year period, we prospectively compared the two scoring systems in 103 patients undergoing an emergency appendectomy to treat acute appendicitis. Statistical analysis was comparatively done by ANOVA utilizing statistical software (SPSS), Microsoft Excel datasheets, and calculation of statistical significance using the McNemar Chi square test.

**Results:** The RIPASA scale was more appropriate than the modified ALVARADO scale, according to the diagnostic accuracy results, which were 95.15% for the RIPASA score and 64.08% for the Modified Alvarado score.

**Conclusion**: Thus based on the greater sensitivity, the RIPASA score is a better tool in the evaluation of suspected appendicitis in the South Asian population.

**Keywords**: Acute Appendicitis; Modified Alvarado Score; RIPASA score; Diagnosis.



## Introduction

In clinical practice, the most frequent occurring surgical emergencies acute appendicitis, with approximately one in seven lifetime prevalence rate [1]. Professor Reginald Fitz initially referred to the condition as appendicitis in his historical study published in 1886 [2]. Appendicitis' cause is still not entirely established. Appendicitis' is a disorder that is characterized by appendix inflammation. The risk of rupture, which could cause peritonitis and shock, makes untreated patients far more likely to have significant mortality rate [3]. Anorexia is the first sign of appendicitis in 95% of cases, which is then followed by vomiting and then abdominal pain. When pain is followed by vomiting, appendicitis should be suspected rather than assumed [4]. Acute appendicitis is diagnosed only through a clinical history, physical exam, and laboratory tests like an increased white cell count. Even though

acute appendicitis is a common issue, the diagnosis is still challenging [5]. There are several scoring systems that have been employed to help with the early identification of acute appendicitis and its timely treatment. These scorings are based on the clinical history, physical examination, and lab results. New diagnostic scoring systems, Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) and ALVARADO score, which were developed for the diagnosis of acute appendicitis, were found to have much higher specificity, sensitivity and diagnostic accuracy [6]. The Alvarado scoring system excludes some factors, including as age, gender, symptom duration, and urinalysis but comparatively the RIPASA rating system is simple and includes these factors [7, 8]. The Alvarado scoring system, one of the most used scoring systems, has sensitivity and specificity ranges of 53% to 88% and 75% to 80%, respectively [9, 10]. Modification to this is MASS (Modified Alvarado scoring system) [11].

Acute appendicitis has recently been investigated as a diagnostic modality, and imaging techniques like computed tomography (CT), magnetic resonance imaging (MRI) and ultrasonography have been found to increase diagnosis accuracy and patient outcomes. However, it is not clearly established that all people should routinely have imaging exams [12]. Imaging becomes more crucial for the diagnosis of appendicitis in patients who are pregnant, old, or female. Due to the absence of preoperative imaging confirmation, it has long been recognized that 20% of appendiceal specimens will be normal [13]. In some categories, such as fertile females (30.4%) as opposed to males (16.3%), this negative appendectomy rate is higher [14]. Imaging can lower the rate of unsuccessful appendectomies to about 3%, particularly in facilities that regularly perform CT scans for appendicitis suspicion. However, if surgery is delayed, there may be a larger perforation rate [15].

To evaluate the diagnosis precision in acute appendicitis with a lower rate of negative appendectomy, we prospectively compared the RIPASA score with the modified Alvarado score using both measures on patients undergoing emergency appendectomy.

## Material and Methods

This observational, cross-sectional, institution based comparative study was conducted in department of General Surgery, Katihar Medical College and Hospital, Katihar in all patients having an emergency appendectomy to treat an acute appendicitis that is currently being treated over a two-and-a-half-year period from May 2018 to October 2020. This study included a total of 103 patients.

### Inclusion criterion

Patients who present with severe right iliac pain could results in an acute appendicitis.

### Exclusion criterion

Appendicular lump was excluded. Other causes of acute right iliac fossa pain like ruptured ectopic pregnancy, twisted/ruptured ovarian cyst, pelvic inflammatory disease, ureteric colic, Meckel's diverticulitis diagnosed pre or per-operatively were also excluded.

### Parameters to be Studied

* Score according to the MODIFIED ALVARADO System
* Score according to the RIPASA System
* Histopathological reports.

ANOVA comparisons utilizing readily available statistical software (SPSS), Microsoft Excel datasheets, and calculation of statistical significance using the McNemar Chi square test are all examples of appropriate statistical techniques.

## Results

In both genders males and females, the incidence increases in the second decade. The age range of 10 to 30 years is represented by 66% of all appendicitis patients. Although there is a 1.6:1 gender disparity, both male and female exhibit the

same distributional pattern with age (Table 1).

In the second and third decades, acute appendicitis is more common. Gangrenous and perforated appendix is more common in third and fourth decade. Out of the 120 patients recruited, only 103 patients satisfied the study inclusion and exclusion criteria. The patients' mean age (43 males, 60 female) was 26.24 SD 10.53 years. Based on the surgeons' clinical judgement, 103 patients had emergency appendectomy. Out of these, only 81 cases were confirmed histologically for acute appendicitis among them 63 (61.1%) cases are simple acute appendicitis, 4 (3.8%) cases had perforated appendicitis, 13 (12.6%) cases had gangrenous appendicitis and 1 (0.9%) had appendicular abscess (Figure 2). Total 22 cases were free of acute appendicitis whereas histology specimens showed normal appendix, indicating a negative appendectomy rate of 21.3% (Table 2).

The distribution of the 103 patients in four groups was done according to the RIPASA score at a cut-off threshold score of 7.5 and the Modified Alvarado score at a cut-off threshold of 7.0. The RIPASA score correctly classified 79 (97.5%) patients confirmed with histological acute appendicitis to the high-probability group (RIPASA score $\geq$ 7.5) compared with 69 (55.5%) patients with Modified Alvarado score $\geq$ 7.0 (Table 3, $p < 0.001$). The 36 patients who were missed by the Modified Alvarado score were classified wrongly into the false negative group with Modified Alvarado score < 7.0. This number was significantly higher than those wrongly classified as false negative by the RIPASA score ($p < 0.001$).

Both the RIPASA and Modified Alvarado scores correctly classified 19 (86.3%) and 21 (95.4%) patients without acute appendicitis into the true negative group with scores < 7.5 and < 7.0, respectively. There was no statistical significance between the true negative groups ($p=0.599$). The mean total RIPASA scores for each group are shown in Table 3. True positive cases received mean total RIPASA scores of 9.5 SD1.5 (7.5-14.5), while true negative cases received mean scores of 6.1 SD 1.02. (Range 4.5–7.0).

At the optimal cut-off threshold score of 7.5 for the RIPASA score, the calculated sensitivity and specificity were 97.53% (95% confidence interval [CI] 91.44%-99.32%) and 86.36% (95% CI 66.66%-95.25%), respectively compared with 55.55% (95% CI 44.73%-65.88%) and 95.45% (95% CI 78.2%-99.19%), respectively for Modified Alvarado score at an optimal cut-off threshold of 7.0 (Table 4).

Compared to the Modified Alvarado score, which had PPV and NPV of 97.82% (95% CI 88.67%-99.62%) and 36.84% (95% CI 25.52%-49.82%), respectively, the RIPASA score's PPV and NPV were 96.34% (95% CI 89.79%-98.75%) and 90.47% (95% CI 71.09%-98.75%) (Table 4). In comparison to the Modified Alvarado score, the NPV for the RIPASA score was significantly greater ($p < 0.001$). The diagnostic accuracy was 95.15% (95% CI 89.14%-97.9%), for the RIPASA score and 64.08% (95% CI 54.46%-72.69%) for the Modified Alvarado score, showing a difference of 31.07% ($p < 0.001$), which was statistically significant (Figure 5). This difference of 31.07% equates to a total of 34 patients with confirmed histological acute appendicitis who were missed from being diagnosed by Modified Alvarado score. The predicted negative appendectomy rates for both the RIPASA and Modified Alvarado scores were 3.66% and 2.18% respectively, which was not statistically significant ($p= .947$). The table 2 below shows Mc Nemar chi-square test which shows the result that there are statistically significant differences in the diseased group but statistically non-significant differences in the non-diseased group.

So, in this case there are significant differences in the RIPASA Score as it has more true positive cases in comparison to Modified Alvarado Score (Figure 3 and Figure 4).

**ROC (Receiver Operating Curve) of RIPASA Score**: The area under curve is 0.961; p value = <0.001; 95% Confidence interval of area under curve = 0.924 – 0.998. The extreme point of left upper quadrant coincides with the highest sensitivity (97.50%) and specificity (86.40%) and here it is corresponding to RIPASA score 7.5 (Figure 6).

**Table 1: Patients' Demographics (n=103)**

| Age Group | Male | | Female | | Total |
|---|---|---|---|---|---|
| | No. | % | No | % | |
| ≤ 10 yrs. | 3 | 2.91 | 0 | 0.00 | 3 |
| 11-20 yrs. | 7 | 6.80 | 28 | 27.18 | 35 |
| 21-30 yrs. | 19 | 18.45 | 14 | 13.60 | 33 |
| 31-40 yrs. | 9 | 8.73 | 14 | 13.60 | 23 |
| 41-50 yrs. | 4 | 3.88 | 4 | 3.88 | 8 |
| 51-60 yrs. | 1 | 0.97 | 0 | 0.00 | 1 |

Minimum Age- 9 years; Maximum Age-60 years; Mean Age- 26.24±10.53 years

**Table 2: Correlation of Significant Value of Modified Alvarado Score (7) with Histopathology**

| Histopathology | Modified Alvarado Score ≥ 7 | Modified Alvarado Score < 7 | Total |
|---|---|---|---|
| Acute Appendicitis | 45 | 36 | 81 |
| Normal Appendix | 1 | 21 | 22 |
| Total | 46 | 57 | 103 |

**Table 3: Statistically and non-statistically significant differences in the different groups**

| Groups | RIPASA | | Modified ALVARADO | |
|---|---|---|---|---|
| | ≥7.5 | <7.5 | ≥7 | <7 |
| Diseased | 45 | 00 | 34 | 02 |
| Non Diseased | 01 | 00 | 02 | 19 |

RIPASA: Mc Nemar chi-square test done; p<.001; Modified ALVARADO: Mc Nemar chi-square test done; p>.05

**Table 4: Diagnostic Accuracy between Modified Alvarado and RIPASA Score**

| Parameter | Modified Alvarado | RIPASA |
|---|---|---|
| Sensitivity | 55.55% | 97.53% |
| Specificity | 95.45% | 86.36% |
| Positive Predictive Value | 97.82% | 96.34% |
| Negative Predictive Value | 36.00% | 90.47% |

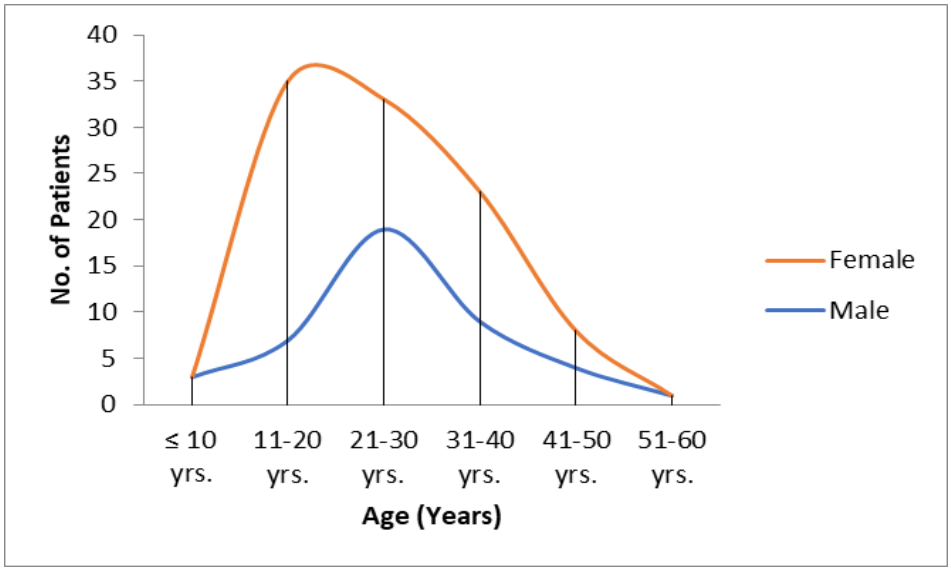


**Figure 1: Pattern of Distribution According to Age and Sex**

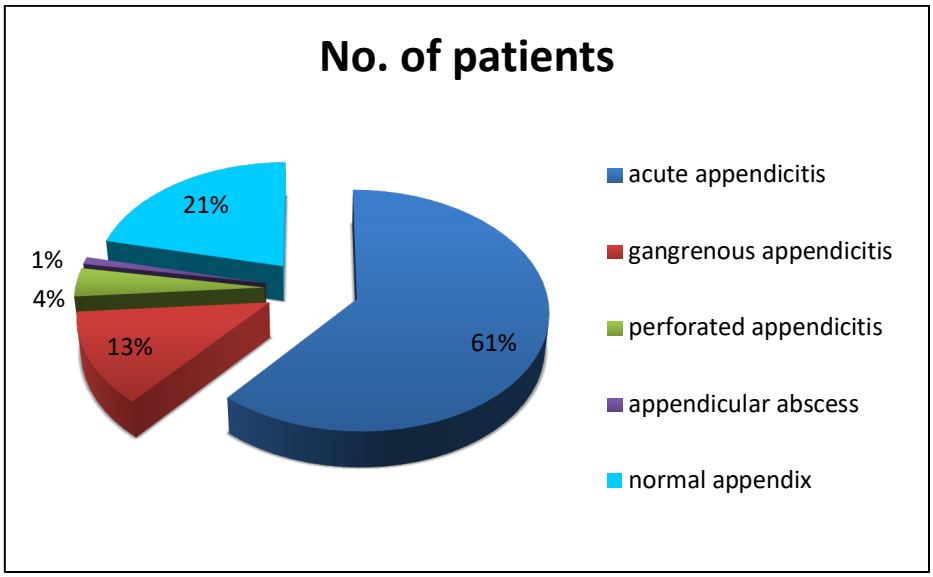


**Figure 2: Diagrammatic Representation of Appendicular Pathologies**

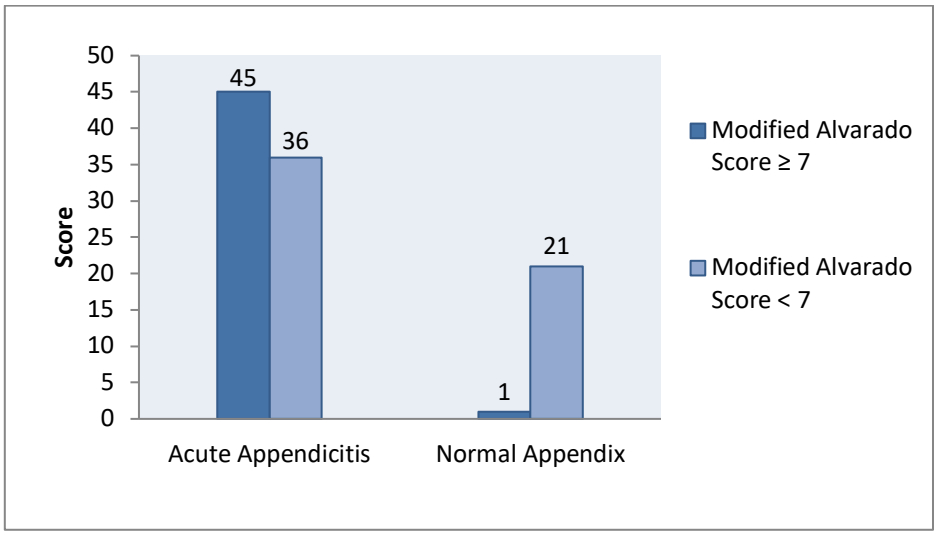


**Figure 3: Correlation of Significant modified Alavarado Score (7) with Histopathology**

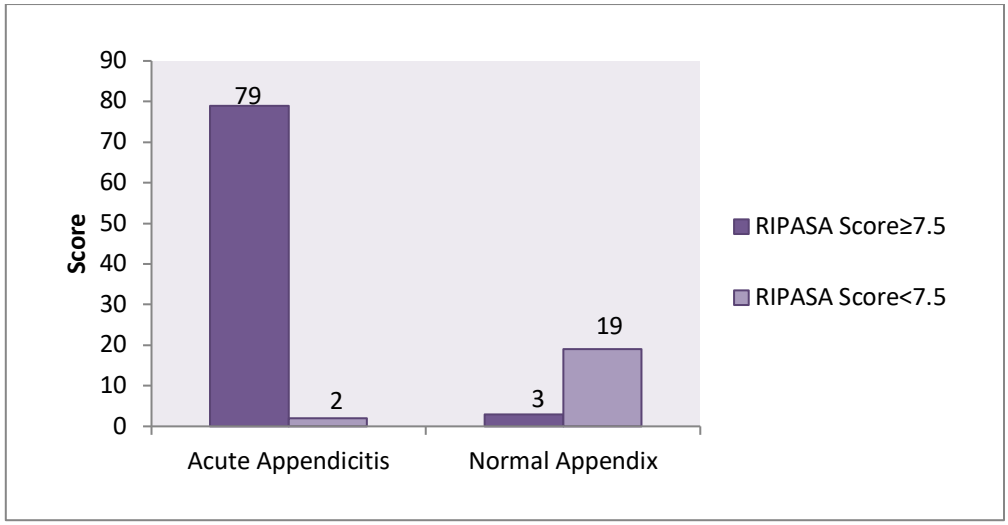


**Figure 4: Correlation of Significant RIPASA Score (7.5) with Histopathology**

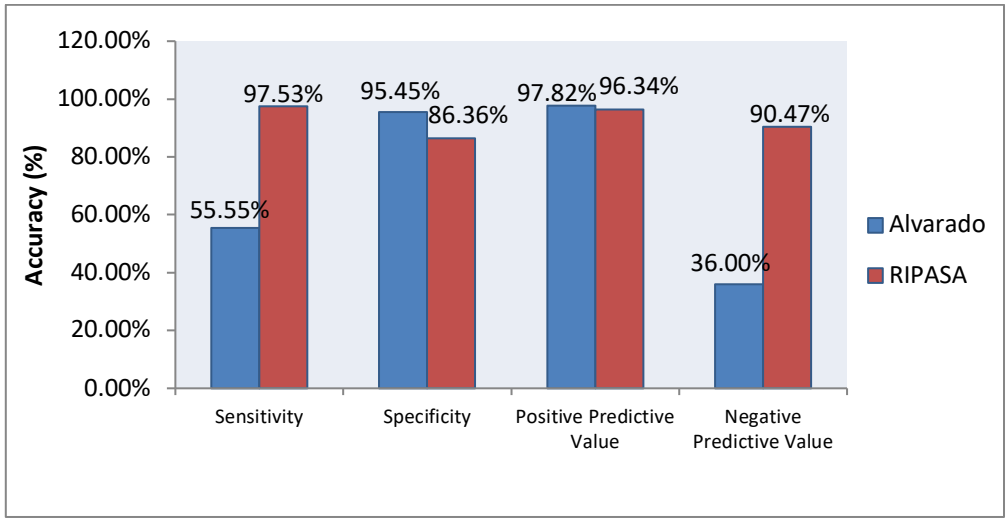


**Figure 5: Graph depicting Diagnostic Accuracy (%) between Modified Alvarado and RIPASA score of all parameters**

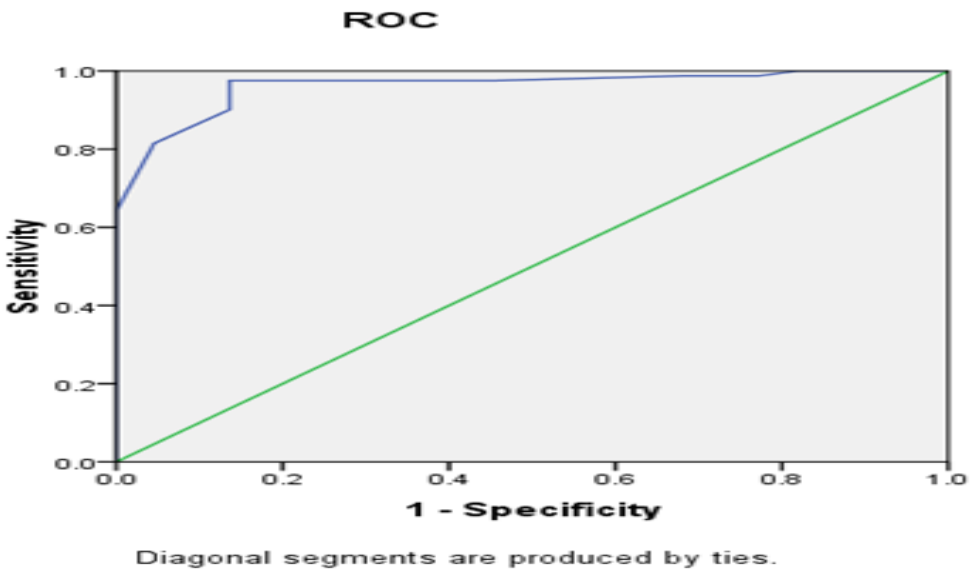


**Figure 6: Graph depicting Receiver operating curve (ROC)**

## Discussion

One of the most frequent causes of acute abdominal pain is acute appendicitis, which presents general surgeons with a significant diagnostic challenge because of its clinical heterogeneity and high prevalence [16]. Even with the tremendous promise of a variety of diagnostic tools in clinical practice, it is still difficult to detect an acute appendicitis early enough to avoid surgical intervention and save healthcare expenses [17, 18]. One of the most typical surgical emergencies experienced by surgeons is acute appendicitis with emergency appendectomy making up one in ten of all emergency abdominal surgeries [19, 20]. It is challenging to diagnose acute appendicitis quickly and accurately so that an early appendectomy can be performed while avoiding perforation-related complications. The expense of healthcare will increase significantly as a result of radiological modalities. According to a recent study, such indiscriminate CT imaging use could result in the early diagnosis of low-grade appendicitis and the needless operation of an appendix in cases where antibiotic therapy would have otherwise prevented the development of the ailment [21]. Furthermore, complications connected to appendicitis inflammation aggravate the patient's prognosis, highlighting the importance of establishing predictive scoring system [17].

Utilizing clinical scoring systems in this situation can assist medical professionals in making better decisions, managing patients, and identifying appendicitis suspects [16]. When attempting to clinically diagnose appendicitis in patients who are suspected, RIPASA and modified Alvarado are the most frequently used scoring system [18]. To compare these two scores in terms of sensitivity and specificity, we conducted a systematic review in this study.

Our findings demonstrate that the RIPASA score has higher sensitivity but lower specificity than the Alvarado score, which is consistent with earlier data. This indicates that while the RIPASA score has a stronger potential to predict patients with acute appendicitis, it also produces a large percentage of false positives. Therefore, when selecting the best test for the clinical setting, these findings should be taken into account. The Alvarado score's sensitivity (59%) and specificity (23%) in an Asian population were demonstrated to be inferior by the RIPASA score's sensitivity (88%) and specificity (67%) in a retrospective analysis [19]. The RIPASA score's high sensitivity (97.5%) and NPV (90.4%) can also aid in reducing unnecessary and costly radiological studies like routine CT imaging, which further reduces annual healthcare spending.

For accepting an operational technique, the RIPASA score stipulates a cutoff value of 7.5. The acquired data's analysis demonstrates consistency with this cutoff point ($p=<0.001$). With regard to the South Asian population, this hypothesis suggests that the cutoff threshold of 7.5 on the RIPASA scale is more appropriate.

## Conclusion

Scoring systems for acute appendicitis is necessary for the emergency scenario for avoiding negative appendectomy, with MODIFIED ALVARADO score and RIPASA score being established scoring systems for the diagnosis of acute appendicitis. The sensitivity, specificity, positive predictive value and negative predictive value of the RIPASA score in this study are 97.53%, 86.36%, 96.34% and 90.47%, respectively. The RIPASA score is a better tool for evaluating suspected appendicitis based on more sensitivity and negative predictive value than modified ALVARADO.

**Ethical approval:** This study was approved, and Institutional Ethics Committee, India, have recommended the decision [IEC/ IRB No.: KMC/ IEC/ 2018-2021/ 011/ MS (Gen. Sur.)].

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Author Contributions:** Equal to all

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Acknowledgements:** The authors thank the patients who participated, and Gen. Sur. Staff. The authors thanks Aziz Writing Solutions for assisting in manuscript preparation and publication.

## References

1. Stephens P, Mazzucco J. Comparison of ultrasound and the Alvarado score for the diagnosis of acute appendicitis. Connecticut medicine 1999; 63(3): 137-40.
2. Fitz RH. Perforating inflammation of the vermiform appendix; with special reference to its early diagnosis and treatment. 1. The American Journal of the Medical Sciences (1827-1924) 1886(184): 321.
3. Bhabatosh D, Singh G, Sambhaji Kh LL, Singh R, Sharma L. Comparison between RIPASA and Alvarado score in the Diagnosis of Acute Appendicites. Int J Curr Res 2016; 1: 25538-546.
4. Jaffe B, Berger D. Chapter 30. The Appendix. Schwart's Principles of Surgery 9th ed New York, NY: McGraw-Hill 2010.
5. Gilmore O, Browett J, Griffin P, Ross I, Brodribb A, Cooke T, et al. Appendicitis and mimicking conditions: a prospective study. The Lancet 1975; 306(7932): 421-4.
6. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Annals of emergency medicine 1986; 15(5): 557-64.
7. Malik MU, Connelly TM, Awan F, Pretorius F, Fiuza-Castineira C, El Faedy O, et al. The RIPASA score is sensitive and specific for the diagnosis of acute appendicitis in a western population. International journal of colorectal disease 2017; 32: 491-7.
8. Siddiqui ZR, Khaliq T, Shah SA. A new simple scoring system for the diagnosis of acute appendicitis. J Pak Med Stud 2011; 1(2): 32-7.
9. Kalan M, Talbot D, Cunliffe W, Rich A. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Annals of the Royal College of Surgeons of England 1994; 76(6): 418.
10. Al-Hashemy AM, Seleem MI. Appraisal of the modified Alvarado score for acute appendicitis in adults. Saudi Med J 2004; 25(9): 1229-31.
11. Old JL, Dusing RW, Yap W, Dirks J. Imaging for suspected appendicitis. American family physician 2005; 71(1): 71-8.
12. Kohl CA, Chivers FS, Lorans R, Roberts CC, Kransdorf MJ. Accuracy of chemical shift MR imaging in diagnosing indeterminate bone marrow lesions in the pelvis: review of a single institution's experience. Skeletal radiology 2014; 43: 1079-84.
13. Ghazi R Q, Yousef K, Ismael M, Sabah AN. Acute Appendicitis in North of Jordan-A 10 year Survey. 2008.
14. Malkomes P, Edmaier F, Liese J, Reinisch-Liese A, El Youzouri H, Schreckenbach T, et al. DIALAPP: a prospective validation of a new diagnostic algorithm for acute appendicitis. Langenbeck's Archives of Surgery 2021; 406: 141-52.
15. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World journal of emergency surgery 2020; 15: 1-42.
16. Pinto F, Pinto A, Russo A, Coppolino F, Bracale R, Fonio P, et al. Accuracy of ultrasonography in the diagnosis of acute appendicitis in adult patients: review of the literature. Critical ultrasound journal 2013; 5(1): 1-3.
17. Ozkan S, Duman A, Durukan P, Yildirim A, Ozbakan O. The accuracy rate of Alvarado score, ultrasonography, and computerized tomography scan in the diagnosis of acute appendicitis in our center.

Nigerian journal of clinical practice 2014; 17(4): 413-8.
18. Timilsina BR, Shah R, KC SR, Upadhyay HP, Lamsal S, Belbase N, et al. RIPASA vs Modified Alvarado Scoring System for diagnosis of Appendicitis. Journal of College of Medical Sciences-Nepal 2018; 14(4): 213-6.
19. Abdeldaim Y, Mahmood S, Mc Avinchey D. The Alvarado score as a tool for diagnosis of acute appendicitis. Irish medical journal 2007; 100(1): 342-.
20. Rodrigues W, Sindhu S. Diagnostic importance of Alvarado and RIPASA Score in acute appendicitis. Int J Sci Study 2017; 4(11): 57-60.
21. Chong CF, Thien A, Mackie AJA, Tin AS, Tripathi S, Ahmad M, et al. Evaluation of the RIPASA Score: a new scoring system for the diagnosis of acute appendicitis. Brunei Int Med J 2010; 6(1): 17-26.