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A Study of Severity of Acute Pancreatitis with Correlation Between Modified Marshall Score and Ct Severity Index

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A B S T R A C T

Background: Acute pancreatitis (AP) is a potentially life-threatening condition with variable outcomes. Early and accurate assessment of severity is crucial for determining prognosis and guiding treatment. This study aims to evaluate the correlation between the CT Severity Index (CTSI) and the Modified Marshall Score (MMS) in assessing AP severity.

Methods: A prospective, cross-sectional study conducted at Fakhruddin Ali Ahmed Medical College, Barpeta, India, over one year. Fifty patients diagnosed with acute pancreatitis were included. CTSI and MMS were calculated and correlated with clinical outcomes.

Results: A significant correlation was found between CTSI and MMS ($r = 0.386$, $p = 0.006$). Higher CTSI and MMS scores were associated with complications and prolonged hospital stays. The study showed that these scores have predictive value for clinical outcomes.

Conclusion: CTSI and MMS are effective tools for stratifying the severity of acute pancreatitis, with a significant correlation between them. Their combined use enhances prognostic accuracy and assists in clinical decision-making.

Keywords: Acute pancreatitis, CT Severity Index, Modified Marshall Score, Severity assessment, Prognostic tools.

INTRODUCTION

Acute pancreatitis (AP) is a potentially life-threatening inflammatory condition of the pancreas, often presenting as acute abdominal pain with variable clinical outcomes. While most cases are mild and self-limiting, about 20–30% of patients develop severe pancreatitis with local or systemic complications, multiorgan failure, and increased mortality rates [1]. This disease has a diverse etiology including gallstones, alcohol abuse, trauma, and drugs, and it remains a significant cause of hospital admissions and intensive care utilization in India and worldwide [2].

A prompt and accurate assessment of the severity of acute pancreatitis is essential in determining the prognosis, guiding appropriate treatment, and reducing complications. Several scoring systems have been developed to evaluate the severity, including Ranson's criteria, the APACHE II score, and the Glasgow scale. However, imaging-based methods, such as the Computed Tomography Severity Index (CTSI) and its improved variant, the Modified CTSI (MCTSI), have become critical tools for diagnosis and prognostication [3].

CT imaging, especially contrast-enhanced computed tomography (CECT), plays a vital role in identifying necrosis, fluid collections, and extra pancreatic complications. The Modified CTSI incorporates pancreatic inflammation, necrosis, and organ complications, offering a better correlation with clinical outcomes compared to the original Balthazar CTSI [4].

According to Indian studies, the MCTSI has a significant association with prolonged hospital stay, intensive care needs, surgical interventions, and mortality [5].

In parallel with radiological scoring, clinical scoring systems like the Modified Marshall Scoring System are routinely used for early risk stratification. The Modified Marshall Score evaluates organ failure across three systems—respiratory, renal, and cardiovascular—and classifies severity based on the presence and persistence of organ failure [6]. As recommended by the Revised Atlanta Classification, organ failure persisting for more than 48 hours is a marker of severe acute pancreatitis.

Several Indian studies have evaluated the utility of the Modified Marshall Score as an early predictor of severity and found strong correlations with mortality and duration of hospital stay. In a tertiary care center study, patients with mild Marshall scores had uneventful recoveries, while all fatalities occurred in patients with severe scores. Respiratory failure was the most common organ system affected, followed by renal and cardiovascular systems [7].

Moreover, the integration of both clinical and radiological scoring systems provides a more comprehensive assessment of AP severity. A prospective Indian study comparing the Modified Marshall Score and the CTSI showed a strong positive correlation between the two scores. A Spearman's rho value of 0.772 confirmed this significant association, validating the combined use of both methods in routine clinical practice [8].

A similar prospective study from Jammu and Kashmir observed that patients classified as severe by the CTSI had significantly worse outcomes, including higher rates of organ failure, infection, and mortality. The CTSI had a stronger statistical correlation with clinical endpoints such as length of hospital stay and need for intervention, suggesting it may be more effective than the conventional CTSI [5].

Additionally, CT scoring systems have been evaluated for their reproducibility and prognostic accuracy. In a landmark study, the CTSI correlated more closely with clinical outcomes such as infection, ICU stay, surgical need, and mortality, compared to the original CTSI. It also demonstrated excellent interobserver agreement, making it a reliable radiologic tool [9].

Furthermore, research comparing multiparameter scores like Ranson, Marshall, and CTSI with biological markers such as procalcitonin showed that these scores had a strong correlation with biochemical inflammation markers, especially in patients with systemic complications. The Modified Marshall Score and CTSI both showed significant positive correlation with elevated procalcitonin levels, underlining their prognostic relevance [10]. Together, the Modified Marshall Score and the CTSI offer complementary insights into the severity of acute pancreatitis. While one assesses systemic organ dysfunction clinically, the other evaluates structural damage and complications through imaging. Their correlation and individual strengths make them essential components in the management and outcome prediction of AP in both Indian and global settings.

Accurate and early assessment of AP severity is crucial for prognosis, timely intervention, and efficient resource allocation. Multiple scoring systems have been developed to assess severity, including Ranson's criteria, APACHE II, and the Glasgow scale. However, two of the most widely accepted and clinically relevant tools are the **CT Severity Index (CTSI)** and the **Modified Marshall Scoring System (MMS)**. The **CT Severity Index (CTSI)** is a radiological scoring system based on contrast-enhanced computed tomography (CECT). It evaluates pancreatic inflammation, necrosis, and extrapancreatic complications. The MCTSI is an improved version of the original Balthazar CTSI, offering greater correlation with clinical outcomes, such as infection, need for intervention, ICU admission, and mortality [9]. It is especially useful for predicting local complications and guiding the need for invasive management.

On the other hand, the **Modified Marshall Scoring System (MMS)** is a clinical tool used to assess systemic organ failure. It evaluates three major organ systems—respiratory, renal, and cardiovascular. A score of 2 or more in any system indicates organ dysfunction. Persistent organ failure (>48 hours) as per the Revised Atlanta Classification defines severe AP [11]. MMS is valued for its simplicity, non-invasive nature, and effectiveness in the early clinical setting, especially in resource-limited environments.

The comparison between CTSI and MMS is clinically important because they provide complementary insights—CTSI reflects structural damage seen in imaging, while MMS assesses systemic physiological impact. Understanding the correlation between these two scoring systems can help clinicians better stratify risk, guide management strategies, and optimize resource utilization. A positive correlation supports their combined use for a holistic approach in both high-tech and resource-constrained settings.

The **CT Severity Index (CTSI)** offers several advantages in the assessment of acute pancreatitis. It is an objective and reproducible tool that provides detailed visualization of pancreatic and peripancreatic changes, such as necrosis, fluid collections, and extrapancreatic complications [9]. The CTSI has demonstrated a strong correlation with local complications and is particularly useful for surgical planning and monitoring disease progression [12]. However, it also has limitations. It requires contrast-enhanced CT imaging, which may not be readily available in all clinical settings and is contraindicated in patients with renal dysfunction or contrast allergies. Additionally, CT imaging is not ideal for early diagnosis, as it may not reveal significant findings in the initial phase of disease, and it is not suitable for hemodynamically unstable patients [13].

In contrast, the **Modified Marshall Score (MMS)** is a simple, bedside clinical tool that assesses the severity of systemic organ dysfunction by evaluating respiratory, renal, and cardiovascular systems. It allows for early identification of severe acute pancreatitis based on organ failure, without the need for imaging or specialized equipment, making it particularly useful in resource-limited settings [11]. Its utility in predicting severity and mortality has been validated in several studies [14]. However, MMS also has disadvantages. It is less specific to pancreatic pathology and does not account for local complications such as necrosis or fluid collections. Moreover, its accuracy may vary depending on clinical interpretation, leading to potential interobserver variability [15].
The present study was designed to explore the correlation between the CTSI and MMS in patients with acute pancreatitis. By comparing these two scoring systems, the study aims to validate their combined utility in predicting disease severity and outcomes.

METHODOLOGY

1. Study Design
This was a prospective, cross-sectional observational study conducted to assess the severity of acute pancreatitis and to determine the correlation between the Modified Marshall Score and the CT Severity Index (CTSI).

2. Study Setting
The study was conducted in the Department of General Surgery at Fakhruddin Ali Ahmed Medical College and Hospital, Barpeta, a tertiary care teaching hospital with necessary radiological and laboratory facilities.

3. Study Duration
The study was carried out over one year, from June 2021 to May 2022, allowing for adequate patient recruitment and follow-up within the hospital setting.

4. Participants – Inclusion and Exclusion Criteria
Patients above 18 years with abdominal pain and CT-confirmed acute pancreatitis were included. Exclusions were post-surgical or traumatic pancreatitis, pancreatic cancer, normal enzyme/CT findings, pregnancy, and chronic pancreatitis.

5. Study Sampling
A consecutive sampling method was used. All patients meeting inclusion criteria during the study period were enrolled after obtaining informed consent.

6. Study Sample Size
Based on previous incidence rates and standard formula, the required sample size was calculated to be 43.4. A total of 50 patients were included for better reliability.

7. Study Groups
No intervention groups were formed. Patients were classified as having mild, moderate, or severe pancreatitis based on their Modified Marshall and CTSI scores.

8. Study Parameters
Parameters assessed included clinical features, biochemical tests (amylase, lipase, creatinine), Modified Marshall Score (organ dysfunction), and CTSI (inflammation, necrosis, complications).

9. Study Procedure

Eligible patients were evaluated clinically, lab tests were done, and CT scans were performed within 48 hours. Modified Marshall Scores were calculated at admission and after 48 hours. CT scores were calculated from scan findings.

10. Study Data Collection

Data were recorded in a structured proforma and entered into Microsoft Excel. Completeness was checked, and data were later transferred to SPSS for statistical analysis.

11. Data Analysis

Analysis was done using SPSS version 21. Descriptive statistics, chi-square, t-tests, and Spearman's correlation were used. A p-value <0.05 was considered statistically significant.

12. Ethical Considerations

Ethical approval was obtained from the institutional ethics committee. Written informed consent was taken from all participants, and confidentiality was maintained throughout the study.

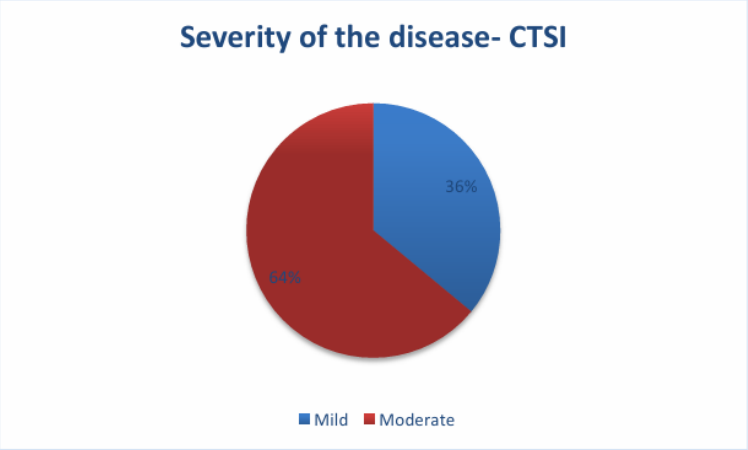
RESULTS

1. Distribution of Study Participants According to CT Severity Index (CTSI)

A majority of participants (64%) had moderate severity on CT imaging, while 36% had mild pancreatitis, indicating significant radiological involvement in most cases (Table 1).

Table 1: Distribution of Study Participants According to CT Severity Index (CTSI)

CT Severity Index	N (%)
1	3 (6%)
2	15 (30%)
3	11 (22%)
4	14 (28%)
5	5 (10%)
6	2 (4%)



Graph 1: Distribution of Study Participants According to CT Severity Index (CTSI)

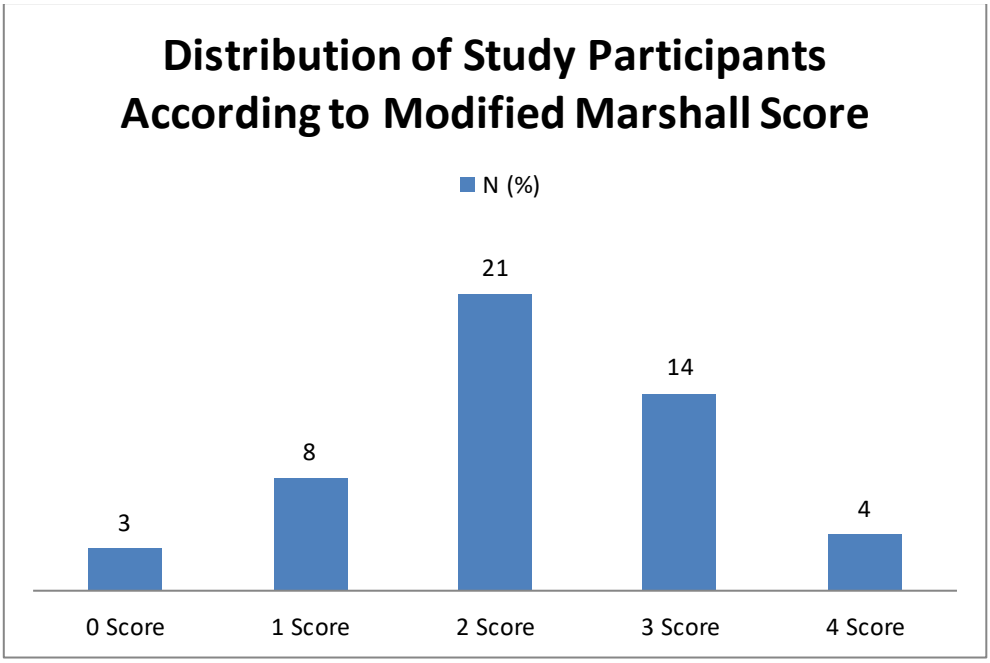
2. Distribution of Study Participants According to Modified Marshall Score

About 36% of patients had Modified Marshall Scores >2, suggesting organ failure and severe disease in over one-third of the cohort (Table 2).

Table 2: Distribution of Study Participants According to Modified Marshall Score

Modified Marshall Score	N (%)
0	3 (6%)
1	8 (16%)

2	21 (42%)
3	14 (28%)
4	4 (8%)



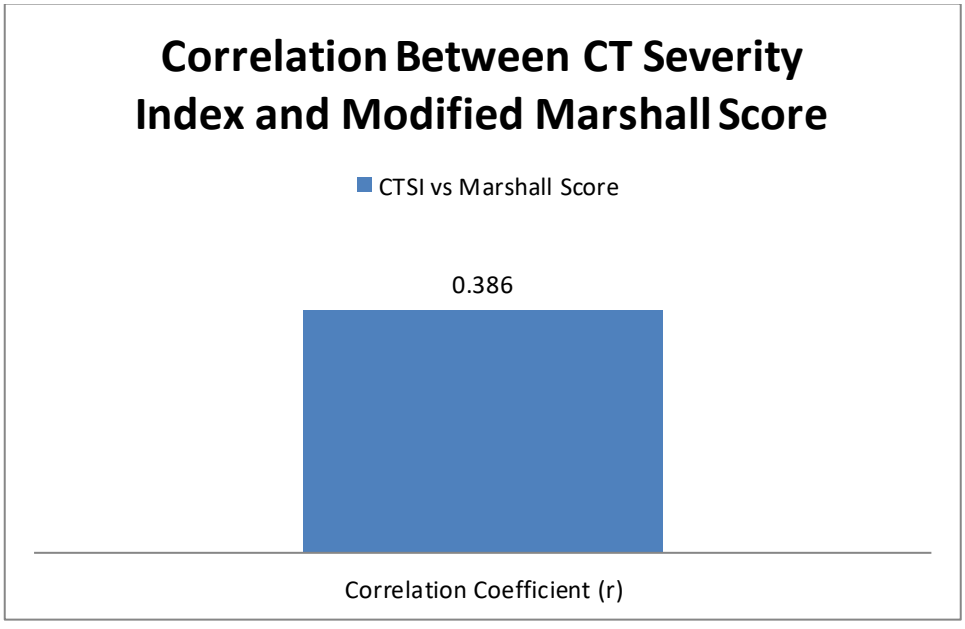
Graph 2: Distribution of Study Participants According to Modified Marshall Score

3. Correlation Between CT Severity Index and Modified Marshall Score

A significant correlation was observed between CTSI and Modified Marshall Score ($r = 0.386, p = 0.006$), confirming that both scores reflect disease severity consistently (Table 3).

Table 3: Correlation Between CT Severity Index and Modified Marshall Score (n=50)

Parameters	Correlation Coefficient (r)	p-value
CTSI vs Marshall Score	0.386	0.006



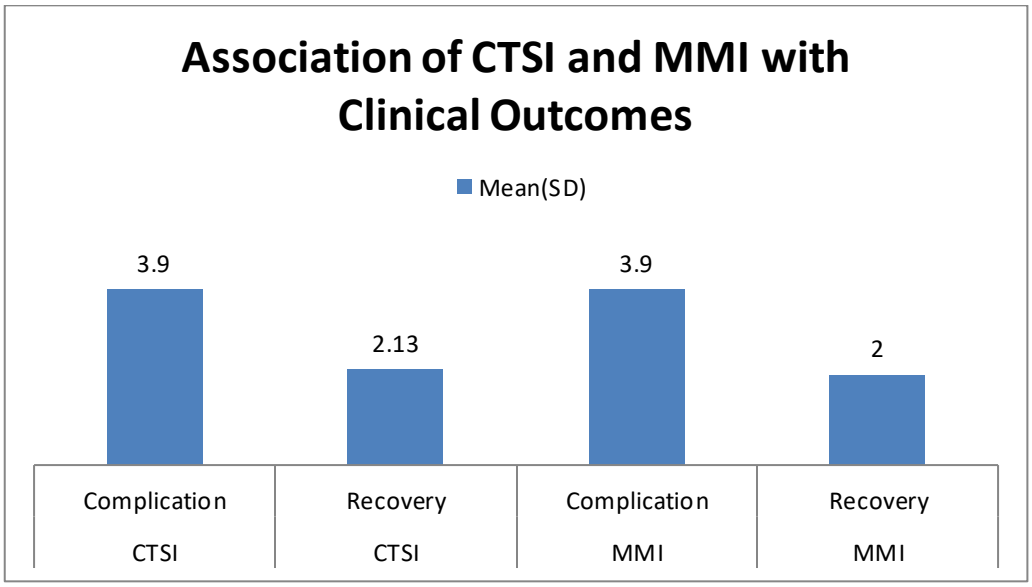
Graph 3: Correlation Between CT Severity Index and Modified Marshall Score

4. Association of CTSI and MMS with Clinical Outcomes

Mean CTSI and Marshall Scores were significantly higher in patients who developed complications ($p < 0.05$), indicating their predictive value for poor outcomes (Table 4).

Table 4: Association of CTSI and MMS with Clinical Outcomes

S. No.	Variables	Mean(SD)	F value	Mean Difference	95% CI	p value
1.	CTSI					
	Complication	3.9(±1.1)	0.412	2.95	1.09-3.339	0.03
	Recovery	2.13(±1.2)				
2.	MMI					
	Complication	3.9(±0.9)	0.02	4.085	1.164-5.334	0.012
	Recovery	2.00(±1.1)				



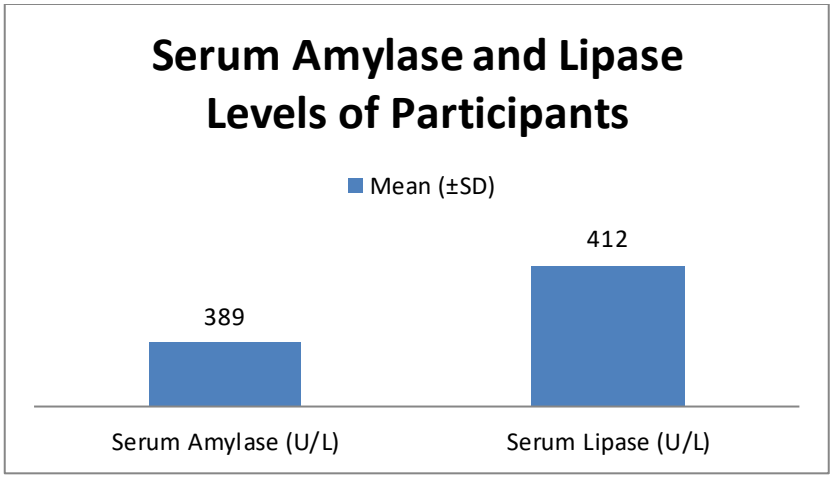
Graph 4: Association of CTSI and MMI with Clinical Outcomes

5. Serum Amylase and Lipase Levels of Participants

All patients had elevated amylase and lipase levels, with means of 389 and 412 respectively, confirming biochemical evidence of acute pancreatitis (Table 5).

Table 5: Serum Amylase and Lipase Levels of Participants

Parameter	Mean (±SD)	Minimum	Maximum
Serum Amylase (U/L)	389 (112)	234	787
Serum Lipase (U/L)	412 (189)	332	928



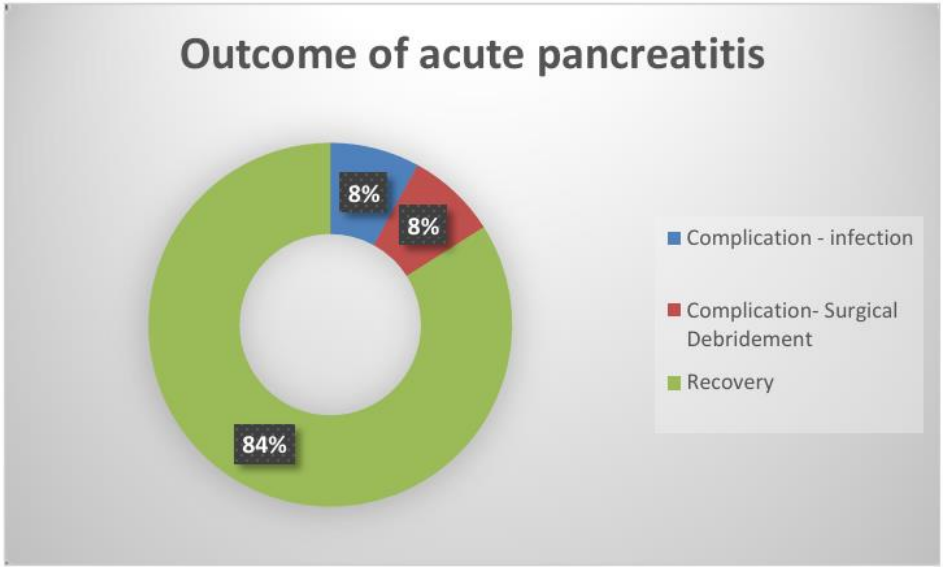
Graph 5: Serum Amylase and Lipase Levels of Participants

6. Outcome Distribution of Study Participants

Most patients (84%) recovered without complications, while 8% required surgical debridement and another 8% developed infections highlighting the clinical spectrum of disease outcomes (Table 6).

Table 6: Outcome Distribution of Study Participants

Outcome	**N (%)**
Complication – Infection	4 (8)
Complication – Surgical Debridement	4 (8)
Recovery	42 (84)



Graph 6: Outcome Distribution of Study Participants

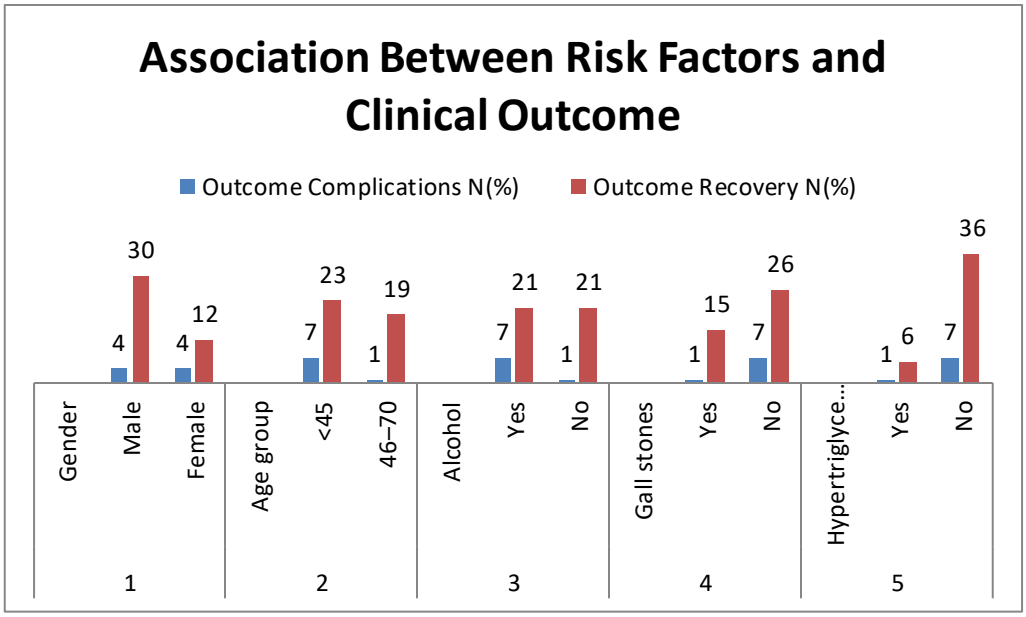
7. Association Between Risk Factors and Clinical Outcome

Alcohol (p = 0.049) and gallstones (p = 0.034) showed significant association with complications, confirming their role as key predictors of adverse outcomes in acute pancreatitis (Table 7).

Table 7: Association Between Risk Factors and Clinical Outcome

S. No.	**Parameters**	**Outcome**		**p value**
		Complications N(%)	**Recovery** N(%)	
1.	**Gender**			0.234

	Male	4 (50)	30 (71.4)	
	Female	4 (50)	12 (28.6)	
2.	**Age group**			0.083
	<45	7 (87.5)	23 (54.8)	
	46–70	1 (12.5)	19 (45.2)	
3.	**Alcohol**			**0.049**
	Yes	7 (87.5)	21 (50)	
	No	1 (12.5)	21 (50)	
4.	**Gall stones**			**0.034**
	Yes	1 (12.5)	15 (36.6)	
	No	7 (87.5)	26 (63.4)	
5.	**Hypertriglyceridemia**			0.894
	Yes	1 (12.5)	6 (14.3)	
	No	7 (87.5)	36 (85.7)	



Graph 7: Association Between Risk Factors and Clinical Outcome

DISCUSSION

In the present study, the severity of acute pancreatitis was assessed using two standardized tools CT Severity Index (CTSI) and Modified Marshall Score (MMI) to evaluate their correlation and clinical utility. Our findings demonstrated that a significant proportion of patients had moderate disease on imaging (64%) and Modified Marshall Scores >2 (36%), suggesting notable systemic and local involvement.

The correlation between CTSI and MMI scores was statistically significant ($r = 0.386$, $p = 0.006$), indicating that both radiological and clinical assessments align in stratifying disease severity. This finding is consistent with the results reported by Banday et al. (2015), who found that CTSI strongly correlated with clinical outcomes such as infection, organ failure, and hospital stay duration [2]. Similarly, Kapali (2019) also demonstrated that higher CTSI scores were predictive of complications and ICU admission [5].

The predictive value of both scores was further supported in our study by the significantly higher mean CTSI (3.9 vs. 2.13; $p = 0.03$) and MMI (3.9 vs. 2.0; $p = 0.012$) in patients who developed complications. This is in agreement with Mortele et al. (2004), who established that the CTSI had a better correlation with clinical outcomes compared to the original Balthazar Index [9]. Additionally, our findings are similar to those of Vashistha et al. (2023), who concluded that the Modified

Marshall Score effectively predicted severity and prognosis in acute pancreatitis, especially in resource-limited settings [7].

Biochemically, all patients in our study showed elevated serum amylase and lipase, with mean values of 389 U/L and 412 U/L respectively, supporting the diagnostic accuracy of enzyme-based screening. These values are comparable to those observed in studies by Shrivastava (2020) and Singh et al. (2021), where high enzyme levels were integral to confirming acute pancreatitis [8, 6]. Our study reinforces the clinical relevance of both Modified Marshall Score and CTSI in early identification of severe acute pancreatitis, with their combined use offering improved prognostic accuracy.

Most patients (84%) recovered without complications, while 16% developed adverse outcomes such as infection and surgical debridement, indicating the variable severity of acute pancreatitis. Alcohol use ($p = 0.049$) and gallstone disease ($p = 0.034$) were significantly associated with complications, making them key predictors of poor prognosis in this cohort. These results are consistent with findings from Banday et al. (2015), who reported higher rates of local and systemic complications in alcohol- and gallstone-related pancreatitis [2]. Recognizing alcohol and gallstones as high-risk etiologies can aid early triage and management. When combined with clinical scoring tools, such insights can help predict complications and improve patient outcomes.

CONCLUSION

This study confirms the significant correlation between the CT Severity Index (CTSI) and the Modified Marshall Score (MMS) in assessing the severity of acute pancreatitis. Both scoring systems reflect disease severity consistently, with higher scores being predictive of complications and poor clinical outcomes. The use of CTSI and MMS together provides a comprehensive assessment of both local and systemic involvement, aiding in early prognosis and improving the management of acute pancreatitis in clinical settings. This study is particularly relevant for optimizing AP management in diverse healthcare settings, including those with limited access to imaging technology.

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