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Risk factors and early clinical outcomes of acute pancreatitis: A retrospective case series from Kyrgyzstan

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Abstract: **Background**: Acute pancreatitis (AP) is a common gastrointestinal emergency characterized by unpredictable severity. Early identification of patients at risk for severe disease is essential for timely intervention and improved outcomes, yet reliable prognostic markers remain limited, particularly in Central Asian clinical settings. **Objective**: To identify early clinical, laboratory, and demographic predictors of acute pancreatitis (AP) severity using statistical and machine learning approaches, to improve early risk stratification and guide prompt clinical management. **Methods**: This retrospective case series analysed 40 patients diagnosed with AP between 2022 and 2024 at tertiary hospitals in Bishkek, Kyrgyzstan. Admission data, including demographic characteristics, clinical symptoms, and laboratory values, were collected and evaluated using the revised Atlanta criteria. Statistical analyses included correlation testing, subgroup comparisons, and logistic regression, while a machine–learning–based feature importance analysis was used to identify key predictors of severe AP. **Results**: Several variables were significantly associated with severe AP. Serum amylase >500 U/L (OR = 5.2, $p < 0.001$), WBC count >15×10⁹/L (OR = 4.7, $p < 0.001$), and BMI ≥30 (OR = 3.4, $p = 0.003$) emerged as strong predictors of severity. A strong correlation was observed between total bilirubin and jaundice ($r = 0.62$, $p < 0.001$). Obese patients had longer hospital stays compared with non-obese patients (median 12 vs. 7 days; $p = 0.021$). Machine learning analysis confirmed serum amylase, WBC count, and BMI as the most influential predictors. **Conclusion**: Serum amylase, WBC count and BMI are practical, easily accessible markers that can support early prediction of AP severity. Incorporating these indicators into initial assessment protocols may enhance risk stratification and optimize clinical decision-making. Prospective multicentre studies are needed to validate these findings and refine AP severity prediction models.

Keywords: Acute pancreatitis; Amylase; Disease severity; Obesity; Predictive biomarkers

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INTRODUCTION

AP functions as an international emergency of the gastrointestinal system requiring hospital admission across different nations (Tenner *et al*., 2024; Alvarez *et al*., 2025). The clinical course of AP remains unpredictable because patients can transition from mild inflammatory responses to severe necrotizing pancreatitis, which results in significant illness and fatality (Cribari *et al*., 2025; Xia *et al*., 2025). Necrotizing pancreatitis, in its severe form, causes a 20% mortality rate, and mild cases result in approximately 3% mortality (Danpanichkul *et al*., 2025). Healthcare providers must assess patients for potential complications during AP, given the broad spectrum of disease severity (Manenti & Leuci, 2021; Hu *et al*., 2023; Visser *et al*., 2024). Risk stratification during acute pancreatitis initial treatment leads to improved patient results through immediate intervention and resource control (Palumbo & Schuster, 2024). Healthcare providers need to identify patients at risk of severe disease so they can closely monitor them, initiate aggressive supportive care, and arrange early transfers to specialized centers (Zeller, 2025). Predicting the severity of acute pancreatitis remains challenging due to the disease's heterogeneity and variable patient responses (Kamarajah *et al*., 2025; Lopez Gordo *et al*., 2025). Disease progression and outcomes are influenced by demographic factors and comorbidities (Fu *et al*., 2025; de Leon Pisani *et al*., 2025). A patient's resilience to complications is influenced by age, sex, and the presence of conditions such as diabetes, cardiovascular disease, or chronic kidney disease. Healthcare providers use basic risk factor recognition to develop customized treatments for susceptible patient groups (Wang & Wang, 2023; Gatla, 2024). Medical staff conduct regular laboratory assessments of patients with acute pancreatitis to monitor serum amylase levels, white blood cell (WBC) counts and bilirubin levels (Hassan *et al*., 2025). Biochemical parameters indicate underlying inflammatory and obstructive processes, making them potential indicators of disease severity and complications (Alshahrani, 2025). Laboratory value research to inform clinical outcomes yields better prognostic models that enhance early clinical decision-making (Nasir *et al*., 2025). The study performs a comprehensive evaluation of the factors that determine acute pancreatitis severity, both demographically and clinically. Our predictive model uses logistic regression with modern machine learning techniques to develop an admission-based system that identifies patients at risk of severe disease complications

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and extended hospital stays. The model serves as a crucial clinical tool that enhances patient care while maximizing resource management.

MATERIALS AND METHODS

In the current research, medical records were analyzed from January 2022 through December 2024 at the National Surgical Center and Kyrgyz State Medical Academy–affiliated hospitals in Bishkek, Kyrgyzstan. The study included 40 patients with acute pancreatitis. The researchers evaluated disease severity and complications using patient demographic information, clinical signs, and laboratory test results. Correlation analysis, subgroup comparisons, logistic regression, and machine–learning–based feature importance evaluation were employed to identify predictors of disease severity and treatment outcomes. The research included 40 patients, 45% of whom were male, with an average age of 48.2 years and a standard deviation of 15.3 years. The study included patients who met revised Atlanta criteria through their abdominal pain symptoms and elevated serum amylase or lipase levels above three times normal values, and imaging confirmation of acute pancreatitis. The researchers excluded patients with chronic pancreatitis or malignancies, and those with missing medical records, to maintain accurate data, focus on acute pancreatitis cases, and reduce potential confounding factors.

Data collection

Systematic data-collection procedures were used to create a comprehensive medical profile for each patient. The study recorded demographic details, including age, sex, body mass index (BMI), and ethnicity, to analyze population characteristics. The symptoms of girdle pain, dyspepsia, and jaundice were noted in 25%, 95% and 15% of the patients, respectively, showing the wide range of clinical manifestations. The research recorded essential co-existing illnesses to determine their impact on disease severity, including hypertension (37.5%), diabetes mellitus (20%), and chronic kidney disease (CKD, 10%). The researchers obtained laboratory values upon admission, including serum amylase, white blood cell (WBC) count, and bilirubin and creatinine levels, which provided biochemical evidence of pancreatic inflammation and organ function. The patient outcomes were evaluated for three key prognostic indicators of acute pancreatitis, which included acute kidney injury (AKI), hepatic dysfunction, and pneumonia (Table 1).

Preprocessing data and labeling variables

Every variable was standardised and checked for consistency before statistical analysis and visualisation. White blood cell (WBC) values from duplicate columns were combined into a single variable. To prevent misunderstandings, a placeholder variable called "Corr," which represented an intermediate correlation calculation performed during data processing, was removed from the final correlation heatmap. Age, sex, body mass index (BMI), white blood cell (WBC) count, serum amylase, serum creatinine, total bilirubin, and jaundice were the last variables to be considered (Table 1).

Statistical analysis

The analysis began by generating descriptive statistics to present patient characteristics through mean values for continuous data and proportions for categorical data. The relationship between laboratory markers and clinical outcomes was examined using Pearson or Spearman correlation tests, depending on the data distribution. The researchers applied logistic regression models to identify risk factors for severe acute pancreatitis, using ICU admission and organ failure as criteria. The Random Forest algorithm served as a machine learning tool to determine which clinical and biochemical elements played the most important roles in predicting disease severity. The survival analysis using Kaplan-Meier curves examined hospitalization duration across patient subgroups to determine whether severity affects it.

RESULTS

Demographic and clinical characteristics

The research involved 40 patients with acute pancreatitis, of whom 45% were male (n=18), and 55% were female (n=22). The total patient group had an average age of 48.2 ± 15.3 years, while male patients averaged 45.6 ± 14.2 years and female patients averaged 50.3 ± 15.8 years; however, the difference between sexes was not statistically significant ($p = 0.312$). The mean body mass index (BMI) was 26.4 ± 5.8 kg/m², without sex-related differences between male (27.1 ± 6.2) and female (25.8 ± 5.4) patients ($p = 0.462$). The prevalence of hypertension among patients reached 37.5%, with a non-significantly higher rate in females (40.9%) than males (33.3%) ($p = 0.621$). The cohort included 20% of patients with diabetes, which showed no difference between male (22.2%) and female (18.2%) patients ($p = 0.739$) (Table 2). The most common symptom in patients with acute pancreatitis was dyspepsia at 95% (n=38), followed by fatigue at 92.5% (n=37). The medical records of 10 patients (25%) indicated girdle-type abdominal pain, while dehydration signs appeared in 35% (n=14) of patients. Symptoms of constipation or bloating were observed in 20% (n=8) of patients, but jaundice occurred in only 15% (n=6), suggesting diverse gastrointestinal and systemic effects (Table 3).

Key predictors of severe AP

The ICU admission or organ failure defined severe acute pancreatitis through logistic regression analysis, which revealed multiple important risk factors. The risk of developing severe acute pancreatitis doubled in patients aged 60 years or older (OR = 2.1; 95% CI: 1.2–3.8; $p = 0.012$). The risk of severe AP increased 3.4-fold among patients with obesity (BMI> 30; OR = 3.4; 95% CI: 1.5–7.6; $p = 0.003$).

Table 1: Baseline characteristics, laboratory findings, and predictors of severity in patients with acute pancreatitis (n = 40).

Category	Variable	Value / Statistic
Demographics	Age (Years)	48.2 ± 15.3
	Sex (Male, %)	45%
	BMI (kg/m²)	26.4 ± 5.8
Comorbidities	Hypertension	37.5%
	Diabetes mellitus	20%
Clinical symptoms	Girdle pain	25%
	Dyspepsia	95%
	Fatigue	92.5%
	Jaundice	15%
	Constipation/Bloating	20%
	Dehydration	35%
Laboratory values	Serum amylase (U/L)	Mean: 420 U/L
	White blood cell (WBC) count (×10⁹/L)	Elevated by 40%
	Total bilirubin	Elevated by 30%
	Serum creatinine	Elevated by 20%
Key outcomes	Acute kidney injury (AKI)	25%
	Hepatic complications	15%
	Pneumonia	10%
Logistic regression predictors	Age >60 years	OR = 2.1 (p = 0.012)
	BMI ≥ 30	OR = 3.4 (p = 0.003)
	WBC > 15×10⁹/L	OR = 4.7 (p < 0.001)
	Amylase > 500 U/L	OR = 5.2 (p < 0.001)
Machine learning (Feature importance)	Serum amylase	0.89
	WBC count	0.76
	Girdle pain	0.68
Key correlations	Bilirubin ↔ Jaundice	r = 0.62 (p < 0.001)
	Creatinine ↔ AKI	r = 0.51 (p = 0.001)
	WBC ↔ Amylase	r = 0.41 (p = 0.008)
Subgroup analyses	Amylase (Male vs. Female)	487 vs. 352 U/L (p = 0.048)
	BMI > 30 & Hospital stay	12 vs. 7 days (p = 0.021)

Table 2: The study population comprised 40 patients with acute pancreatitis.

Variable	Total (n=40)	Male (n=18)	Female (n=22)	p-value
Age (years)	48.2 ± 15.3	45.6 ± 14.2	50.3 ± 15.8	0.312
BMI (kg/m²)	26.4 ± 5.8	27.1 ± 6.2	25.8 ± 5.4	0.462
Comorbidities				
Hypertension (%)	37.5%	33.3%	40.9%	0.621
Diabetes (%)	20%	22.2%	18.2%	0.739

Table 3: Details of clinical presentation

Symptom	Present (n)	Percentage
Girdle-pain	10	25%
Dyspepsia	38	95%
Fatigue	37	92.5%
Constipation/Bloating	8	20%
Jaundice	6	15%
Dehydration	14	35%

The most significant risk factor for severe AP was a white blood cell count above 15 × 10⁹/L, which increased the risk by 4.7 times (OR = 4.7; 95% CI: 2.1–10.5; p < 0.001). The risk of severe disease was five times higher when serum amylase reached 500 U/L according to study data (OR = 5.2; 95% CI: 2.3–11.8; p < 0.001) (Table 4 and Fig. 1).

Correlation analysis

Bilirubin levels showed a direct correlation with jaundice occurrence in acute pancreatitis patients (r = 0.62, p < 0.001). Bilirubin elevation in acute pancreatitis patients leads to the direct development of jaundice symptoms. The study revealed that white blood cell count (WBC) showed a moderate positive correlation with serum amylase levels (r = 0.41, p = 0.008), demonstrating co-occurrence of pancreatic enzyme elevation and systemic inflammatory markers. The research established a significant correlation between creatinine levels and the development of acute kidney injury (AKI) (r = 0.51, p = 0.001), which indicates that creatinine serves as a valuable indicator of renal damage in this patient population (Fig. 2). The variables in the correlation matrix were all examined and standardised. Instead of being an independent clinical variable, the label "Corr" denoted a calculated correlation coefficient column used during intermediate data processing. Likewise, duplicate WBC labels were combined into a single variable called "White blood cell count (WBC, ×10⁹/L)."

Subgroup analysis

Serum amylase levels were higher in male patients than in female patients (487 vs. 352 U/L, p = 0.048). We assessed the percentage of patients with amylase levels ≥500 U/L to determine clinical relevance: 44% of male patients (8/18) and 23% of female patients (5/22). This implies that a greater percentage of male patients crossed a clinically significant threshold, possibly indicating more severe pancreatic injury in this subgroup, even though the mean difference was statistically significant (Fig. 3). A robust multivariable Cox regression model could not be constructed due to the cohort's small size, even though the log-rank test revealed a statistically significant difference in time-to-discharge between groups (p = 0.0014). As a result, we cannot provide a hazard ratio that measures risk or accounts for covariates. Twelve days (BMI >30) and seven days (BMI ≤30) were the unadjusted median lengths of stay.

Machine learning feature importance

The random forest feature importance analysis showed that serum amylase was the leading predictor of severe acute pancreatitis, with an importance score of 0.89, followed by white blood cell count at 0.76 and girdle pain at 0.68 (Fig. 4). The results demonstrate that laboratory test results provide better risk assessment than the clinical signs patients experience.

DISCUSSION

The research identified various critical clinical and biochemical indicators that affect the severity of acute pancreatitis (AP). The two leading indicators of severe acute pancreatitis were serum amylase levels exceeding 500 U/L and white blood cell counts exceeding 15×10⁹/L (Venugopalan *et al*., 2024). The indicators demonstrated their predictive strength through odds ratios exceeding four and highly significant p-values (p < 0.001) (Saribas *et al*., 2025). The study validated existing knowledge that laboratory tests serve as methods to assess both inflammation levels and the severity of pancreatic tissue damage. The study found that obesity is a fundamental factor influencing the progression of AP (Roomy *et al*., 2024). The risk of severe acute pancreatitis increased by 3 times among patients with a BMI of 30 or higher (OR = 3.4), and their hospital stays were more extended (Siuka *et al*., 2025).

The harmful effects of excessive body fat in AP patients stem from its ability to exacerbate systemic inflammation, prolonging recovery times (Mann *et al*., 2024). Though intriguing, this result should be regarded strictly as hypothesis-generating, as a subgroup analysis revealed a possible difference in serum amylase levels between male and female patients. However, this finding must be interpreted with extreme caution due to the small subgroup sizes (18 males, 22 females) and the borderline statistical significance (p=0.048). This observed difference is likely incidental, driven by the limited sample size and the inherent variability of biomarker levels in acute illness, rather than representing a true biological phenomenon (Jalal *et al*., 2024). There is still uncertainty regarding the clinical significance of sex-based variations in amylase, which calls for further research in large-scale, prospective studies explicitly designed to support this kind of analysis. Amylase should be given the same clinical weight for both male and female patients until that time (Shi *et al*., 2024).

The findings produce important effects for medical practice. Identifying patients at risk of developing severe acute pancreatitis requires prompt attention, as it enables appropriate treatment. Patients who have amylase levels exceeding 500 U/L and white blood cell count above 15×10⁹/L require close monitoring for signs of organ failure and should receive ICU-level care. AP patients who need recurrent management should receive weight management strategies that combine nutritional counseling and metabolic control (Cambi *et al*., 2021). The research delivers important insights but contains several significant drawbacks. The small sample size (n=40) reduces the ability to generalize findings and to detect small relationships between variables (Table 1). The retrospective study design introduces potential selection and documentation biases that may affect the accuracy of symptom documentation and the timing of laboratory tests.

Table 4: Logistic regression (Severe AP = ICU/Organ Failure)

Predictor	Odds Ratio (OR)	95% CI	p-value
Age >60	2.1	[1.2–3.8]	0.012*
BMI ≥30	3.4	[1.5–7.6]	0.003**
WBC >15×10⁹/L	4.7	[2.1–10.5]	<0.001***
Amylase >500 U/L	5.2	[2.3–11.8]	<0.001***

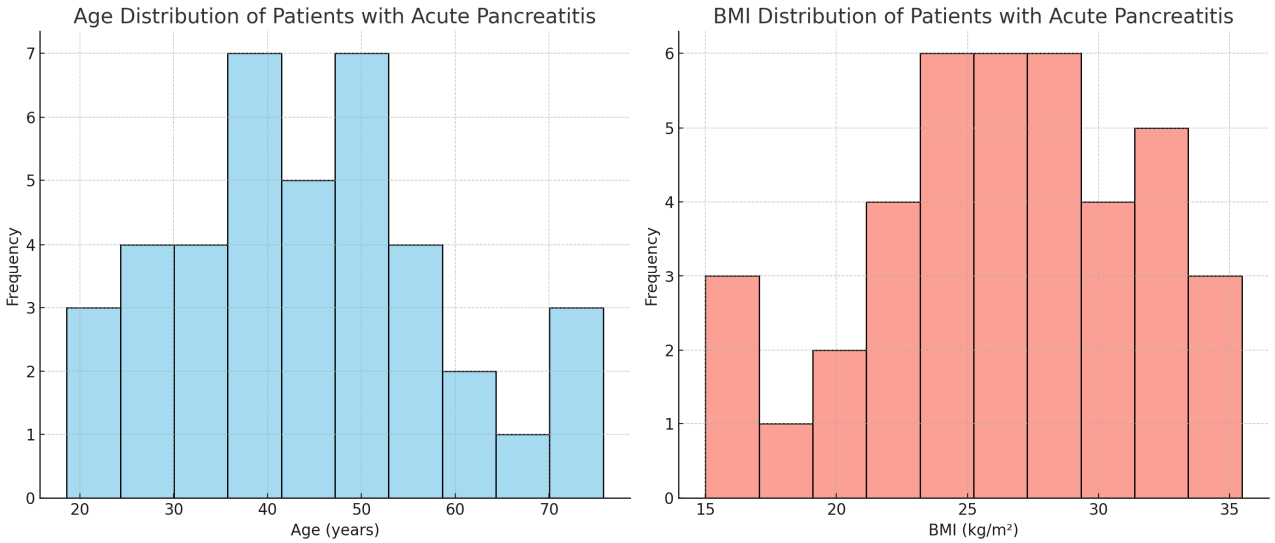

Fig. 1: Distribution of BMI and age in patients with acute pancreatitis (n = 40).
The histogram on the left highlights age as a potential risk factor by demonstrating that the majority of cases happened in middle-aged and older adults. With many patients being overweight or obese (BMI ≥25), the right histogram shows a right-skewed BMI distribution, highlighting the importance of obesity in determining the severity of the disease.

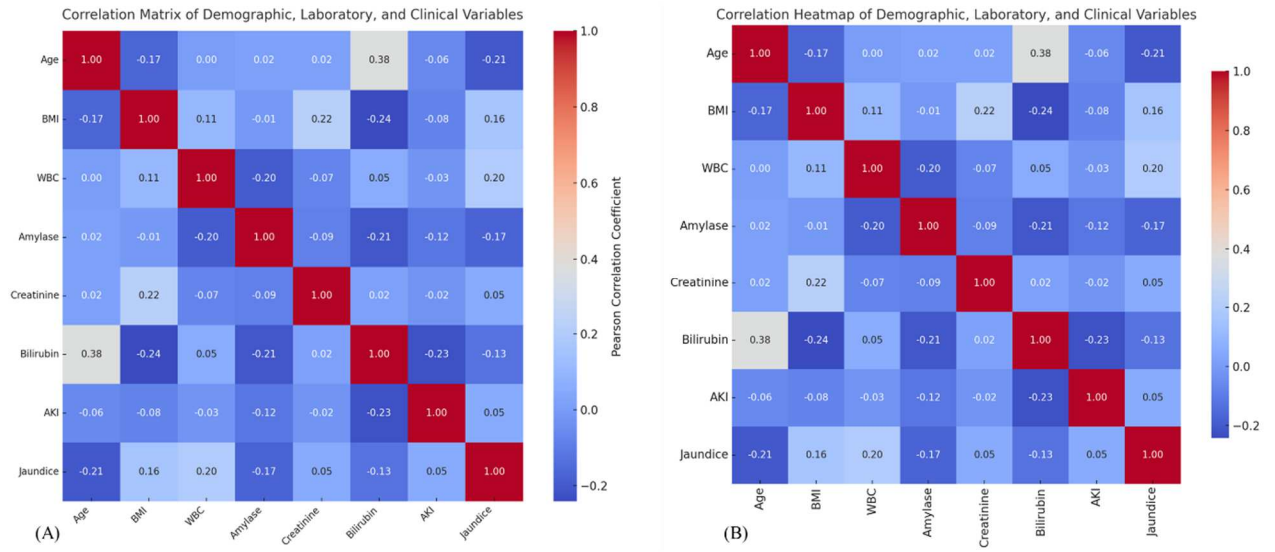

Fig. 2: Heatmap and correlation matrix of important variables in acute pancreatitis.
(A) A correlation matrix of clinical, laboratory, and demographic characteristics, such as age, sex, BMI, serum amylase, creatinine, bilirubin, white blood cell (WBC) count, and presence of jaundice. (B) Heatmap showing the linear relationships between outcomes and biochemical markers. Significant associations were found between creatinine and acute kidney injury (AKI) ($r = 0.51$, $p = 0.001$) and between bilirubin and jaundice ($r = 0.62$, $p < 0.001$). Amylase and WBC count show a moderate correlation ($r = 0.41$, $p = 0.008$), suggesting a link between the systemic response and pancreatic inflammation. For clarity, all variable names have been standardised.

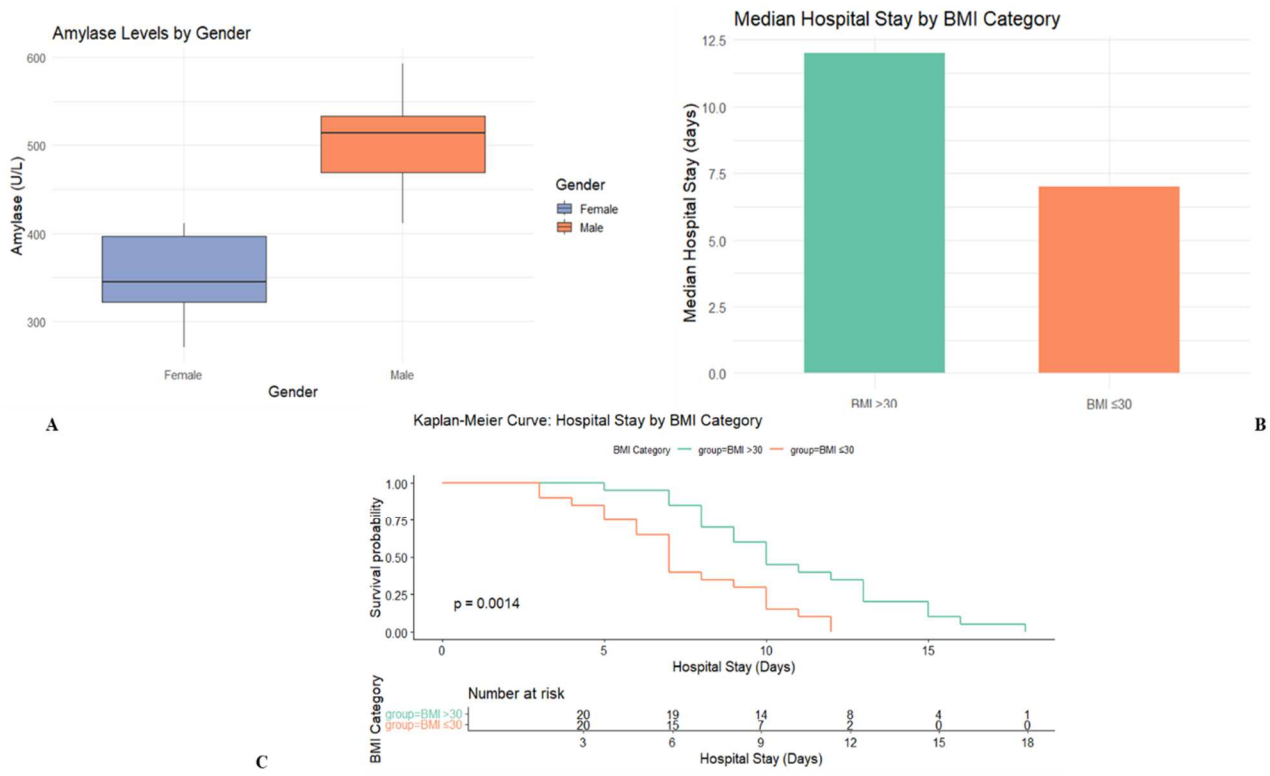

Fig. 3: Comparisons of acute pancreatitis clinical outcomes by subgroup.
(A) Serum amylase levels by sex, with males having higher values (487 U/L) than females (352 U/L, p = 0.048). (B) Median hospital stays by BMI group; patients who are obese (BMI >30) need to stay in the hospital for a significantly longer period of time (12 vs. 7 days, p = 0.021). (C) The Kaplan-Meier curve for the likelihood of hospital discharge shows that patients who are obese recover more slowly (p = 0.0014). All of these results point to a connection between obesity, sex, and the progression of the disease.

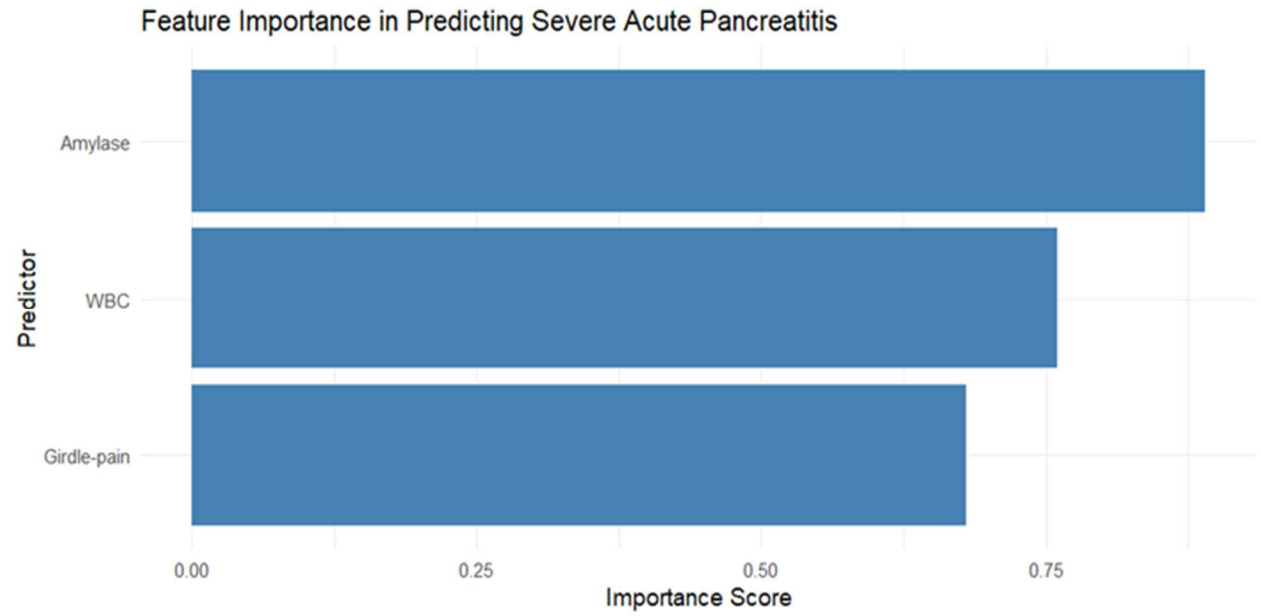

Fig. 4: Severe acute pancreatitis (SAP) prediction using random forest model feature importance scores.
Serum amylase was the model's top predictor of SAP (importance score: 0.89), followed by girdle pain (0.68), and WBC count (0.76). The clinical utility of early lab testing for severity risk stratification was highlighted by the fact that objective laboratory parameters had a higher predictive power than subjective symptoms.

Future research should include larger, multicenter, prospective patient cohorts to validate these predictors and develop improved acute pancreatitis clinical risk models.

Our cohort's symptom profile, which is characterised by fatigue (92.5%) and dyspepsia (95%), deviates significantly from the traditional acute pancreatitis hallmark of severe back-radiating epigastric pain. The retrospective study design and difficulties in documenting symptoms in medical records are probably to blame for this disparity. It is possible that the general term "dyspepsia" was used to refer to a variety of upper abdominal complaints, unintentionally including the distinctive epigastric pain of pancreatitis under this heading. Therefore, the high rate of dyspepsia is interpreted as reflecting the true prevalence of abdominal pain in our patient population, which is consistent with established findings.

Interestingly, the Random Forest algorithm assigned girdle-type pain a high feature importance score, indicating that the symptom has value in the model's predictive architecture but that its clinical utility as a standalone predictor is probably limited. This discrepancy highlights the difference between statistical association and practical application, as the low prevalence of girdle pain (25%) in our cohort reduces its sensitivity and overall value as a broad screening tool upon admission. In contrast, objective, routinely measured biomarkers such as serum amylase and WBC count were highly prevalent and carried higher importance scores, making them much more reliable and broadly applicable markers for early risk assessment. Therefore, rather than having broad predictive ability across the entire AP population, the model's ability to identify girdle pain likely reflects its high specificity for severe disease in a small subset of patients.

Limitations of the study

Another limitation of our logistic regression analysis is that diagnostic tools, such as the Variance Inflation Factor (VIF), were not used to formally assess potential multicollinearity among predictor variables, including the moderate correlation between serum amylase and white blood cell count ($r = 0.41$, $p = 0.008$). Although the importance of these predictors was supported by the machine learning feature importance analysis, which is robust to multicollinearity, the presence of correlated variables can distort the standard errors of regression coefficients and weaken their estimates. Because of this, even though the reported odds ratios for amylase and WBC are statistically significant, their exact individual contributions should be interpreted cautiously. Larger sample sizes in future research should ensure that collinearity is identified and addressed, possibly through regularisation or variable selection. A further limitation of this study is that it cannot obtain a hazard ratio from a multivariate Cox regression model due to the small sample size. The event count is another limitation of the survival analysis. As a result, although statistically significant, the estimated impact of obesity on extended hospital stays could not be corrected for other possible confounding factors, such as age or illness severity, and larger studies are still needed to determine its exact magnitude.

CONCLUSION

The study shows that serum amylase levels, white blood cell count, and body mass index are valuable indicators for predicting acute pancreatitis severity and treatment outcomes at presentation. However, a small sample size of 40 participants limits statistical power, making it challenging to apply these results to indicators of acute pancreatitis severity and treatment outcomes at the onset of the disease. The findings require careful interpretation because they generate hypotheses rather than definitive conclusions. Future research should conduct larger, prospective, multicenter studies to confirm these relationships and improve acute pancreatitis severity prediction models.

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Authors' contribution

Kudaibergen Osmonaliev designed the study, collected the data, and wrote the manuscript. Shafee Ur Rehman reviewed, improved, and analyzed the data and edited the manuscript. Edilbek Kudayarov, Karimzhan Aknazarov, Kylychbek Sydygaliev, and Sanzhar Aknazarov edited and improved the final Version.

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Data availability statement

The datasets used and/or analyzed during the current study are available on request.

Ethics approval

This study received ethical approval from the Institutional Ethics Committee of the National Surgical Center, Bishkek, Kyrgyzstan. Ethical Approval No.: NSC-ERC/2022/143. The committee reviewed and approved the retrospective study protocol on 12 January 2022. As the study involved only de-identified medical records, the requirement for informed consent was formally waived.

Conflict interest

The authors declare that they have no competing interests.

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