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Validation of the Emergency Department Assessment of Chest Pain Score and its accelerated diagnostic protocol in Turkish cohort

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ABSTRACT

Aims: The Emergency Department Assessment of Chest Pain Score (EDACS) and its accelerated diagnostic protocol (EDACS-ADP) are widely used for risk stratification of chest pain patients. This study evaluated their diagnostic performance in a Turkish cohort.

Methods: This retrospective cross-sectional study analyzed patients presenting with chest pain to a Turkish Emergency Department (ED). Major adverse cardiac event (MACE) occurrence was determined through clinical follow-up and medical record review. The diagnostic accuracy of EDACS and EDACS-ADP in predicting MACE was evaluated.

Results: A total of 744 patients were included, with 94 (12.6%) in the MACE group and 650 (87.4%) in the no-MACE group. The median EDACS score was higher in the MACE group (20 [IQR 14-24] vs. 15 [IQR 9.75-20], p<0.001). EDACS sensitivity was 71.3% (95% CI 61.0-80.1), while EDACS-ADP achieved 100% (95% CI 96.2-100.0). Specificity was similar (EDACS: 52.3% [95% CI 48.4-56.2]; EDACS-ADP: 52.2% [95% CI 48.2-56.1]). EDACS-ADP had a higher positive likelihood ratio (PLR) (2.09 [95% CI 1.93-2.26] vs. 1.49 [95% CI 1.28-1.73]) and a lower negative likelihood ratio (NLR) (0 vs. 0.55 [95% CI 0.4-0.76]). Positive predictive value (PPV) was higher for EDACS-ADP (23.2% [95% CI 21.8-24.7]) than for EDACS (17.8% [95% CI 15.7-20.1]), while negative predictive value (NPV) was 100% for EDACS-ADP and 92.6% (95% CI 90.1-94.6) for EDACS.

Conclusion: EDACS effectively identified high-risk patients, while EDACS-ADP achieved 100% sensitivity and NPV, making it a reliable tool for safely discharging low-risk patients in a Turkish ED cohort.

Keywords: Chest pain, scores, adverse cardiac events, diagnostic performance, emergency department

INTRODUCTION

Chest pain is the most common symptom of coronary artery disease (CAD).[1] Although only 5.1% of patients presenting to the emergency department (ED) with chest pain are diagnosed with acute coronary syndrome (ACS), over half of these cases are ultimately attributed to non-cardiac causes.[2] However, CAD affects more than 18.2 million adults in the United States and remains the leading cause of death for both men and women, with over 365.000 deaths annually.[3]

As a result, chest pain is a frequent reason for ED visits (accounting for 4.7% of visits in the U.S., with more than 6.5 million annual visits), yet only a small proportion of these patients experience life-threatening cardiac events or require hospitalization. ACS carries a one-month mortality rate of 5.9%, with more than half of these deaths occurring within the first hour of symptom onset.[4] Therefore, emergency physicians (EPs) must accurately, rapidly, and objectively distinguish patients with potentially serious cardiac conditions requiring immediate intervention from those who do not.[5] The aim is to prevent the unnecessary, costly, and potentially risky hospital admissions and comprehensive evaluations of non-critical patients, thereby optimizing the allocation of limited resources.

To achieve this balance, various diagnostic strategies and modalities have been developed in recent years, including chest pain units (CPUs), new cardiac biomarkers, risk scores, accelerated diagnostic protocols (ADPs), and noninvasive imaging of the myocardium and coronary arteries.[6,7] In this context, several risk stratification scoring systems have been developed in recent years to estimate the risk of major adverse cardiac events (MACE) due to their speed, simplicity, and cost-effectiveness.

One of the commonly used tools to predict MACE in patients with chest pain is the Emergency Department Assessment of Chest Pain Score (EDACS), which was developed using a two-phase process incorporating a statistical model and enhanced clinical practicality and usability.[8] Additionally, by integrating variables such as electrocardiography (ECG) and troponin data, classification systems like the history

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electrocardiogram age risk factor troponin (HEART) score and EDACS with its accelerated diagnostic pathway (EDACS-ADP) have been derived to identify low-risk cases that can be safely discharged from the ED with minimal observation.[9] These classifications aim to manage overcrowding and ensure that ED resources are effectively directed toward the appropriate population. However, there is limited recent evidence regarding the performance of these classifications across different populations and clinical settings.

The aim of our study is to evaluate and validate the performance of EDACS and EDACS-ADP in predicting MACE among patients presenting to our ED with chest pain and to assess the applicability of these tools within the Turkish population.

METHODS

Ethics

This study was conducted as a retrospective cross-sectional analysis at a tertiary ED. Patients presenting with chest discomfort to ED of Memorial Şişli Hospital between January 1, 2021, and January 1, 2024, were retrospectively identified from hospital electronic medical records. The study was approved by the Memorial Şişli Hospital Institutional Ethics Committee (Date: 26.12.2024, Decision No: 004), and patient data were anonymized before analysis. Because the study was designed retrospectively, no written informed consent form was obtained from patients. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patient Selection

Patients aged ≥18 years who presented to the ED with chest pain or chest discomfort were included. Patients were identified using ICD-10 codes for general chest pain (R07.9, R07.1, R07.2, R07.89) and cardiac-related chest pain (I20.0, I20.1, I20.8, I20.9, I21.0-I21.4, I24.9). Patients with missing key data (troponin measurements, electrocardiograms [ECG], or EDACS scores) were excluded. Cases with ST-elevation myocardial infarction (STEMI), known alternative diagnoses requiring immediate intervention (e.g., aortic dissection, pulmonary embolism), were also excluded. Patients who were directly transferred to another facility were excluded only if follow-up data on MACE outcomes were unavailable. Transfers where complete clinical and outcome data could be obtained were retained in the analysis. Only first-time presentations to the ED were included in this study, with repeated visits for the same episode of chest discomfort excluded.

Data Collection

Demographic variables, clinical characteristics, comorbidities, and risk factors for cardiovascular disease were extracted from electronic health records. The EDACS score was calculated for all included patients, and the EDACS-ADP classification was determined based on clinical assessment, ECG findings, and serial high-sensitivity cardiac troponin (hs-cTn) measurements at 0 and 2 hours. hs-cTn assays were performed using the same manufacturer's kit and analyzed on the same device throughout the study period to ensure consistency.

MACE events were identified through electronic health record review, including hospital discharge summaries, procedure reports, and mortality data. Follow-up data for MACE outcomes were obtained from hospital records, national death registries, and outpatient visit documentation. Additionally, patients were contacted via phone calls for outcome verification. Cases were adjudicated by two independent emergency physicians, with discrepancies resolved by consensus.

ECGs were interpreted by emergency medicine specialists with at least six years of experience. Automated ECG readings were not used for classification. Cardiovascular risk factors, including hypertension, diabetes, dyslipidemia, smoking status, and family history of premature CAD, were self-reported by patients.

The primary outcome was the occurrence of MACE within 30 days, defined as a composite of cardiac death, myocardial infarction (MI), or coronary revascularization. Patients lost to follow-up were excluded from the final outcome analysis.

In this study, the EDACS was calculated by assigning specific point values to patient characteristics, including age, sex, cardiovascular risk factors, and symptom characteristics.[10] Age was categorized into predefined groups: 18–45 years (2 points), 46–50 years (4 points), 51–55 years (5 points), 56–60 years (8 points), 61–65 years (10 points), 66–70 years (12 points), 71–75 years (14 points), 76–80 years (16 points), 81–85 years (18 points), and 86 years or older (20 points). Male sex contributed an additional 6 points. Patients with a history of CAD or three or more cardiovascular risk factors—including hypertension, diabetes, dyslipidemia, smoking, or a family history of premature CAD—were assigned 4 additional points. Symptom characteristics modified the total score accordingly: the presence of diaphoresis added 3 points, pain radiating to the arm or shoulder added 5 points, pleuritic pain subtracted 4 points, and palpitation-related pain subtracted 6 points. If any variable required for EDACS calculation was missing, it was considered absent and assigned zero points. The total EDACS score was obtained by summing these variables, with a score of 16 or higher indicating high risk.

The EDACS-ADP was applied by incorporating electrocardiogram (ECG) findings and high-sensitivity cardiac troponin (hs-cTn) measurements at 0 and 2 hours. Patients were classified as low risk if they had an EDACS score below 16, no new ischemic changes on ECG, and negative hs-cTn results at both time points. If any of these criteria were not met, the patient was classified as intermediate or high risk. If an initial hs-cTn result was unavailable, a delayed troponin test was performed. EDACS and EDACS-ADP scores were retrospectively calculated by trained emergency physicians who were blinded to patient outcomes. Interobserver agreement was assessed in a random subset of cases to ensure consistency in scoring.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 30.0 (IBM Corp., Armonk, NY, USA). Continuous

variables were assessed for normality using the Kolmogorov-Smirnov test and histograms and presented as mean±standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables were expressed as frequencies and percentages. Differences between groups were analyzed using the independent samples t-test for normally distributed continuous variables and the Mann-Whitney U test for non-normally distributed continuous variables. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. The diagnostic performance of the EDACS and its EDACS-ADP was evaluated using sensitivity, specificity, PPV, negative predictive value (NPV), positive likelihood ratio (LR+), and negative likelihood ratio (LR–). A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 744 patients were included in the study and were categorized into two groups: the MACE group (n=94, 12.6%) and the No-MACE group (n=650, 87.4%) (Table 1). The mean age of patients in the MACE group was statistically significantly higher compared to the no-MACE group (60.3±14.3 years vs. 54.3±12.8 years, p<0.001, mean difference=6. The proportion of males was statistically significantly higher in the MACE group compared to the no-MACE group. Hypertension was more frequent in patients with MACE (p=0.005), whereas no statistically significant differences were observed for diabetes mellitus (p=0.177), history of CAD (p=0.128), and hyperlipidemia (p=0.141). Current smoking was statistically significantly more common in the MACE group (p=0.016). A positive family history of CAD was also statistically significantly more frequent in the MACE group (p=0.002). Pain exacerbated by inspiration was statistically significantly lower in the MACE group (p=0.002). No statistically significant differences were observed for pain radiating to the shoulder or arm (p=0.588), presence of diaphoresis (p=0.550), or pain reproducible by palpation (p=0.981).

Table 1. Baseline characteristics of patients stratified by the Emergency Department Assessment of Chest Pain Score and its accelerated diagnostic protocol

Characteristic	No MACE (n=650)	MACE (n=94)	p
Age (years), mean±SD	54.3±12.8	60.3±14.3	<0.001
Male sex, n (%)	332 (51.1)	60 (63.8)	0.021
Hypertension, n (%)	190 (29.2)	41 (43.6)	0.005
Diabetes mellitus, n (%)	127 (19.5)	24 (25.5)	0.177
History of coronary artery disease, n (%)	141 (21.7)	27 (28.7)	0.128
Hyperlipidemia, n (%)	130 (20.0)	25 (26.6)	0.141
Current smoker, n (%)	85 (13.1)	21 (22.3)	0.016
Family history of coronary artery disease, n (%)	19 (2.9)	9 (9.6)	0.002
Radiation of pain to shoulder/arm, n (%)	247 (38.0)	33 (35.1)	0.588
Presence of diaphoresis, n (%)	256 (39.4)	34 (36.2)	0.550
Pain exacerbated by inspiration, n (%)	207 (31.8)	15 (16.0)	0.002
Pain reproducible by palpation, n (%)	28 (4.3)	4 (4.3)	0.981

MACE: Major adverse cardiovascular events, SD: Standard deviation

Initial troponin positivity was statistically significantly higher in the MACE group compared to the No-MACE group (p<0.001). Similarly, 2-hour troponin positivity was statistically significantly higher in the MACE group (p<0.001). Ischemic ECG findings were more common in the MACE group (p<0.001) (Table 2).

Table 2. Laboratory findings and risk stratification using the emergency department assessment of chest pain score and its accelerated diagnostic protocol in predicting major adverse cardiovascular events

Category	Characteristic	No MACE (n=650)	MACE (n=94)	p
Laboratory finding	Positive initial troponin, n (%)	24 (3.7)	60 (63.8)	<0.001
	Positive 2-hour troponin, n (%)	31 (4.8)	89 (94.7)	<0.001
	Ischemic ECG findings, n (%)	22 (3.4)	64 (68.1)	<0.001
Risk assessment	EDACS score, median (IQR)	15 (9.75-20)	20 (14-24)	<0.001
	Low-risk EDACS, n (%)	340 (52.3)	27 (28.7)	<0.001
	High-risk EDACS, n (%)	310 (47.7)	67 (71.3)	-
	Low-risk EDACS-ADP, n (%)	339 (52.2)	0 (0.0)	<0.001
	High-risk EDACS-ADP, n (%)	311 (47.8)	94 (100.0)	-

MACE: Major adverse cardiovascular events, ECG: Electrocardiogram, EDACS: Emergency Department Assessment of Chest Pain Score, ADP: Accelerated diagnostic protocol

The median EDACS score was statistically significantly higher in the MACE group (20 vs. 15, p<0.001). Patients classified as low risk by EDACS were significantly lower in the MACE group (p<0.001), while the proportion of high-risk patients was higher. Similarly, patients classified as low-risk by EDACS-ADP were significantly lower in the MACE group (p<0.001), while all MACE cases fell into the high-risk category (100% vs. 47.8%). The sensitivity of EDACS was 71.3% (95% CI 61.0 - 80.1), whereas EDACS-ADP had a sensitivity of 100%. Specificity was similar for both scores (EDACS: 52.3%; EDACS-ADP: 52.2%) (Table 3). The PLR was higher for EDACS-ADP compared to EDACS (2.09 vs. 1.49), and the negative likelihood ratio was lower for EDACS-ADP (0 vs. 0.55). The PPV was higher for EDACS-ADP (23.2% compared to EDACS 17.8%), while the NPV was 100% for EDACS-ADP and 92.6% for EDACS.

Table 3. Validation of the Emergency Department Assessment of Chest Pain Score and its accelerated diagnostic protocol: sensitivity, specificity, and predictive values

Metric	EDACS	EDACS-ADP
Sensitivity (95% CI)	71.3% (61-80.1%)	100% (96.2-100%)
Specificity (95% CI)	52.3% (48.4-56.2%)	52.2% (48.2-56.1%)
Positive likelihood ratio	1.49 (1.28-1.73)	2.09 (1.93-2.26)
Negative likelihood ratio	0.55 (0.4-0.76)	0
Positive predictive value (95% CI)	17.8% (15.7-20.1%)	23.2% (21.8-24.7%)
Negative predictive value (95% CI)	92.6% (90.1-94.6)	100%

EDACS: Emergency Department Assessment of Chest Pain Score, ADP: Accelerated diagnostic protocol, CI: Confidence interval

DISCUSSION

In this study, the diagnostic performance of EDACS and EDACS-ADP in predicting MACE among Turkish patients presenting with chest pain to the ED was evaluated. Our findings demonstrated that EDACS-ADP, with its 96.2–100% sensitivity and 100% NPV, supports the safe early discharge of low-risk patients and thereby promotes efficient resource utilization. However, its specificity of 48.2–56.1% indicates a potential increase in unnecessary diagnostic tests and frequent false-positive results. As for EDACS, its sensitivity of 61.0–80.1% and NPV of 90.1–94.6% suggest limited performance in excluding high-risk patients. Moreover, its specificity of 48.4–56.2% and a negative likelihood ratio of 0.55 highlight the potential risk of false negatives, posing a threat to missing clinically critical cases. Based on these findings, while EDACS-ADP should be used alongside clinical judgment for optimal application in the Turkish population, EDACS may not be sufficient on its own for managing high-risk patients and should be supplemented with additional diagnostic methods.

The current goal of all strategies used to manage ED overcrowding is to ensure the rapid, early, and safe discharge of low-risk patients through accurate classification systems that identify those with low mortality and morbidity risks. Among the ED-based risk stratification tools for chest pain, commonly studied systems include the HEART score (The structure of the five elements with a 0, +1, and +2 scoring system (analogous to the Apgar score) helps to translate a long history and examination of a patient with chest pain into a comprehensible score of 0 to 10. parameters: history, age, risk factors, initial troponin[11]), Vancouver chest pain rule (Step-wise analysis of EKG, biomarker, history and physical exam; if all questions are answered "no," the patient is low-risk by the Vancouver chest pain rule. Parameters: Abnormal initial EKG, Positive troponin at 2 hours, Prior ACS or nitrate use, Does palpation reproduce pain?, Age 50 and above?, Does pain radiate to neck, jaw, or left arm?[12]), ADAPT (2-Hour EDACS-ADP to assess patients with chest pain symptoms using contemporary troponins as the only biomarker[13]), Marburg heart score (Rules out CAD in primary care patients with chest pain. parameters: gender, pain, history[14]), and Global Registry of Acute Coronary Events (*GRACE,* estimates admission to 6 month mortality for patients with ACS. Parameters: age, heart rate/pulse, systolic blood pressure, creatinine, cardiac arrest at admission, ST segment deviation on EKG, Abnormal cardiac enzymes, Killip class (signs/symptoms)[15]).[10] These scoring systems differ in the parameters they use, which results in variations in calculation time, observation duration in the ED, and their ability to predict MACE effectively.

EDACS classifies patients into low-risk and non-low-risk categories based on four key parameters: age, sex, known CAD (or the presence of three or more CAD risk factors), and symptoms.[16] hese four parameters can be assessed within seconds, making EDACS simple to apply and comparable in ease to current ED triage algorithms. Studies have shown that EDACS is more effective than standard ED triage systems in predicting MACE.[16] However, despite its speed and simplicity, EDACS lacks two critical components for chest pain evaluation: ECG and troponin testing. Consequently, shortly after EDACS was introduced, its accelerated version (EDACS-ADP) was developed by incorporating ECG and 2-hour troponin assessment. Although this modification requires more time for calculation and longer ED stays, our study confirmed its superior predictive accuracy.

The main limitation of EDACS-ADP in the ED is the time needed for troponin testing and the processing of follow-up troponin values. This is why, in its initial definition, EDACS-ADP was described as the 2-hour EDACS-ADP version of EDACS. In our study, we observed that troponin positivity at 2 hours was significantly higher in the MACE group compared to the initial troponin levels. However, in the No-MACE group, the highest rates of positivity were also associated with 0- and 2-hour troponin measurements. This highlights the importance of considering non-ACS causes of elevated troponin when interpreting these results. We found similar percentages for low-risk EDACS and low-risk EDACS-ADP among patients in the No-MACE group, indicating that both tools may have comparable utility in identifying low-risk patients.

A key question remains in current ED triage systems: should triage clinicians prioritize identifying high-risk (red) patients or low-risk (green) patients first? If the primary goal is to identify high-risk patients, EDACS-ADP is more suitable due to its superior sensitivity. However, if the goal is to rapidly identify low-risk patients without the need for extended observation, EDACS may be sufficient. Our study suggests that in situations of ED overcrowding, when patient volumes are high, EDACS can be effectively used to identify low-risk patients, saving the time otherwise needed for EDACS-ADP's 2-hour protocol. This advantage could allow emergency physicians to manage patient flow more efficiently while awaiting troponin results when necessary.

Although chest pain is a common reason for ED visits, it does not typically involve the simultaneous arrival of multiple patients, as seen in cases of mass casualties or physical trauma. However, the impact of climate change on CAD epidemiology, ACS management, and changes in ED visit volumes warrants further research to determine whether adjustments in the EDACS and EDACS-ADP thresholds for classification may be necessary.

When initially introduced, EDACS-ADP demonstrated 99–100% sensitivity in accurately identifying low-risk patients and classified approximately 45% of the cohort as low-risk.[10] Similarly, in our study, we observed comparable performance within the Turkish population.

Studies conducted in different populations have provided important evidence supporting the performance of the EDACS-ADP algorithm in classifying chest pain in EDs. In a Canadian study, the algorithm was shown to effectively identify high-risk patients while enabling the safe early discharge of those at low risk and a study conducted in a Turkish cohort found that EDACS-ADP was effective in distinguishing low-risk patients who were unlikely to require urgent intervention.[17,18] Furthermore, Wang and colleagues emphasized that EDACS-ADP can serve as a valuable clinical

tool for identifying low-risk individuals and supporting early discharge decisions in emergency settings.[19]

In summary, we evaluated the use of EDACS-ADP in Turkish EDs for the safe management of chest pain patients and observed that it could be successfully applied within this population. Our findings further highlight the potential for EDACS to be used effectively in specific situations of ED overcrowding, providing emergency physicians with additional flexibility and time management options.

Limitations

This study has several limitations. First, although the derivation of EDACS was originally based on a statistical model derived from prospectively collected data, this study did not modify the original criteria and was retrospective, keeping the diagnostic framework as designed. However, this may limit the exploration of potential adaptations that could improve its performance in specific subpopulations within the Turkish cohort. Future studies may explore the impact of customized adaptations on performance outcomes. Although we observed excellent inter-rater agreement for EDACS and EDACS-ADP in predicting MACE, the interrater reliability of individual clinical variables was not specifically tested. Thus, we cannot fully exclude minor variations in the application of these variables by different clinicians. The study was conducted in a single-center ED in Türkiye, which may limit the generalizability of the findings to different healthcare settings and populations. While our results are consistent with findings from international cohorts, validation in a broader, multicenter context is recommended to ensure wider applicability. Lastly, we used a p-value of <0.05 as the threshold for statistical significance in the multivariate analysis. Although this threshold is commonly used in clinical research, it may restrict the inclusion of additional variables that could further improve the prediction model's accuracy. Future studies may consider incorporating a broader range of variables to enhance diagnostic performance, provided that clinical simplicity is preserved.

CONCLUSION

In this study, the performance of EDACS and EDACS-ADP in predicting MACE among patients presenting with chest pain to the ED was evaluated in a Turkish Cohort. Our findings demonstrated that EDACS-ADP, with its 100% sensitivity and 100% NPV, is a highly reliable tool for identifying low-risk patients who can be safely discharged. Although both scoring systems exhibited similar specificity (EDACS: 52.3%, EDACS-ADP: 52.2%), the higher PLR and PPV of EDACS-ADP further emphasize its clinical utility in improving diagnostic accuracy and optimizing resource allocation.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was approved by the Memorial Şişli Hospital Institutional Ethics Committee (Date: 26.12.2024, Decision No: 004).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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