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Admission Glucose-RDW Hemoglobin Index and in-hospital Mortality in Critically Ill Patients with Acute Myocardial Infarction

Akut Miyokard Enfarktüsü Nedeniyle Kritik Bakım Alan Hastalarda Kabulde Glukoz-RDW Hemoglobin İndeksi ve Hastane İçi Mortalite

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Abstract

Objective: To evaluate the association between a simple admission glucose-red cell distribution width (RDW) hemoglobin index and in-hospital mortality in critically ill adults with acute myocardial infarction (AMI) and to compare its prognostic performance with that of its individual components and related ratios.

Method: This retrospective cohort study used the Medical Information Mart for Intensive Care IV, version 3.1, database. Adults admitted with a primary diagnosis of AMI who had at least one intensive care unit stay during the first hospital admission were screened. The first glucose, hemoglobin, and RDW measurements obtained between 6 hours before and 24 hours after hospital admission were used. The primary index was defined as (glucose in mmol/L + RDW %)/hemoglobin in g/dL. The primary outcome was in-hospital all-cause mortality. Logistic regression, restricted cubic spline analysis, receiver operating characteristic analysis, multicollinearity assessment, and prespecified subgroup analyses were performed.

Results: Among 2901 eligible first-admission AMI hospitalizations who received intensive care, 2861 had all three exposure components available and formed the final cohort. In-hospital deaths occurred in 257 patients (9.0%). Mortality increased across quartiles of the index from 1.1% in quartile 1 to 19.6% in quartile 4. In the primary adjusted model, which included demographics, comorbidities, cardiogenic shock, early invasive mechanical ventilation, early vasopressor use, and creatinine, the index remained associated with in-hospital mortality (odds ratio 1.99, 95% confidence interval 1.59-2.51; p<0.001).

Öz

Amaç: Kritik bakım alan akut miyokard enfarktüslü erişkinlerde basit bir kabul glukoz-eritrosit dağılım genişliği (RDW) hemoglobin indeksinin hastane içi mortalite ile ilişkisini değerlendirmek ve bu indeksin prognostik performansını tekil bileşenler ile ilişkili oranlarla karşılaştırmaktır.

Yöntem: Bu retrospektif kohort çalışmasında Medical Information Mart for Intensive Care IV sürüm 3.1 veritabanı kullanıldı. İlk hastane yatışında birincil tanısı AMI olan ve aynı yatışta en az bir yoğun bakım ünitesi kalışı bulunan erişkinler tarandı. Hastane kabulünden 6 saat önce ile 24 saat sonra arasındaki ilk glukoz, hemoglobin ve RDW değerleri kullanıldı. Primer indeks, (mmol/L cinsinden glukoz + RDW %)/g/dL cinsinden hemoglobin olarak tanımlandı. Primer sonlanım noktası hastane içi tüm nedenli mortaliteydi. Lojistik regresyon, kısıtlı kübik spline analizi, alıcı çalışma karakteristik analizi, çoklu doğrusal bağlantı değerlendirmesi ve önceden tanımlanmış alt grup analizleri yapıldı.

Bulgular: Yoğun bakım alan 2901 uygun ilk yatış AMI olgusunun 2861'inde üç maruziyet bileşeninin tümü mevcuttu ve final kohortu oluşturdu. Hastane içi ölüm 257 hastada (%9,0) meydana geldi. İndeksin çeyrekleri boyunca mortalite, birinci çeyrekte %1,1'den dördüncü çeyrekte %19,6'ya yükseldi. Demografi, komorbiditeler, kardiyojenik şok, ilk 24 saatte invaziv mekanik ventilasyon, ilk 24 saatte vazopressör kullanımı ve kreatinini içeren primer ayarlı modelde indeks hastane içi mortalite ile ilişkili kaldı (olasılık oranı 1,99, %95 güven aralığı 1,59-2,51; p<0,001). Birinci çeyreğe göre

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Abstract

Compared with quartile 1, adjusted odds ratios were 3.03 (95% confidence interval 1.35-6.79) for quartile 2, 5.99 (95% confidence interval 2.75-13.02) for quartile 3, and 9.74 (95% confidence interval 4.45-21.35) for quartile 4. A restricted cubic spline analysis showed a significant overall association and nonlinearity (both p<0.001). The index had the highest area under the curve among predefined benchmarks: 0.753 (95% confidence interval 0.726-0.780), exceeding the glucose/hemoglobin ratio [0.732; 95% confidence interval 0.699-0.762; Δ area under the curve (AUC) 0.021, p=0.041] and glucose alone (0.689; 95% confidence interval 0.651-0.723; ΔAUC 0.065, p<0.001).

Conclusion: A higher admission glucose-RDW hemoglobin index was associated with increased in-hospital mortality in critically ill patients with AMI. The index provided modest but consistent discrimination beyond that of glucose alone and predefined component-based ratios. External validation in independent AMI intensive care cohorts is required before clinical adoption.

Keywords: Blood glucose, hemoglobins, hospital mortality, intensive care units, myocardial infarction, red cell distribution width

Öz

ayarlı olasılık oranları ikinci çeyrek için 3,03 (%95 güven aralığı 1,35-6,79), üçüncü çeyrek için 5,99 (%95 güven aralığı 2,75-13,02) ve dördüncü çeyrek için 9,74 (%95 güven aralığı 4,45-21,35) bulundu. Kısıtlı kübik spline analizi toplam ilişki ve doğrusal olmayan örüntü için anlamlı sonuç verdi (her ikisi de p<0,001). Önceden tanımlanan karşılaştırıcılar arasında indeks en yüksek eğri altında kalan alanı sağladı (0,753; %95 güven aralığı 0,726-0,780) ve bu değer glukoz/hemoglobin oranından [0,732; %95 güven aralığı 0,699-0,762; Δ eğri altında kalan alan (AUC) 0,021, p=0,041] ve tek başına glukozdan (0,689; %95 güven aralığı 0,651-0,723; ΔAUC 0,065, p<0,001) yüksekti.

Sonuç: Daha yüksek kabul glukoz-RDW hemoglobin indeksi, kritik bakım alan AMI hastalarında daha yüksek hastane içi mortalite ile ilişkiliydi. İndeks, tek başına glukoza ve önceden tanımlanmış bileşen temelli oranlara göre sınırlı fakat tutarlı ek ayırım gücü sağladı. Klinik kullanımdan önce bağımsız AMI yoğun bakım kohortlarında dış doğrulama gereklidir.

Anahtar kelimeler: Eritrosit dağılım genişliği, hastane mortalitesi, hemoglobinler, kan glukozu, miyokard enfarktüsü, yoğun bakım üniteleri

Introduction

Acute myocardial infarction (AMI) remains a major cause of early death despite advances in reperfusion, antithrombotic treatment, and contemporary critical care (1,2). Early risk stratification at hospital admission is therefore central to triage, monitoring intensity, and interpretation of short-term outcomes in patients requiring intensive care.

Admission hyperglycemia has been linked to larger infarct burden, hemodynamic instability, and higher mortality in AMI, regardless of known diabetes status (3,4). The glucose level at presentation is clinically available, but its prognostic significance is shaped by both metabolic reserve and acute stress physiology. That feature limits interpretation when glucose is used alone (5,6).

Red cell distribution width (RDW) has also been associated with adverse outcomes after AMI and may reflect inflammation, oxidative stress, ineffective erythropoiesis, and nutritional reserve (7,8). Hemoglobin concentration adds complementary information because oxygen-carrying capacity and anemia burden influence myocardial oxygen supply during ischemia (9,10). A marker that integrates these domains may capture admission risk more completely than any single component.

Several composite indices that include glucose or erythrocyte parameters have been examined in cardiovascular disease, yet many require historical glycemic data, include variables that are not routinely available at presentation, or omit hemoglobin (6,11). Data are limited on whether a simple admission hematometabolic index based only on glucose, RDW, and hemoglobin adds meaningful information in critically ill patients with AMI (12). This study evaluated the association between an admission glucose-RDW hemoglobin index and in-hospital mortality in intensive care unit (ICU)-treated AMI patients and compared its discriminatory performance against predefined single-marker and ratio-based benchmarks.

Materials and Methods

Study Design and Data Source

This retrospective cohort study used the Medical Information Mart for Intensive Care IV (MIMIC-IV) version 3.1 database, which contains deidentified hospital and intensive care records from Beth Israel Deaconess Medical Center (13,14). The study was designed and reported in accordance with the STROBE and RECORD recommendations for observational research using routinely collected health data (15,16). Ethics approval was obtained from the Bezmialem Vakıf University Non-Interventional Clinical Research Ethics Committee (meeting no: 5, decision no: 1, March 31, 2026). The requirement for informed consent was waived because the study used a deidentified critical care database.

Study Population

Hospital admission was used as the temporal anchor. Adults aged 18 years or older were eligible if the first recorded hospital admission had a primary diagnosis of AMI and included at least one ICU stay. AMI was operationalized

with primary-position ICD-9 code 410.x or ICD-10 codes I21-I22, consistent with current diagnostic frameworks for myocardial infarction and acute coronary syndromes (1,2). Only the first hospital admission for each patient was retained.

Admissions were excluded if there was no ICU stay during the index hospitalization; if the discharge time preceded the admission time; if ICU admission preceded hospital admission; or if admission-window glucose, hemoglobin, or RDW were unavailable. Implausible laboratory values were excluded during data extraction. The final cohort was restricted to admissions for which all three exposure components were available within the prespecified exposure window.

Exposure Definition

The primary exposure was the admission glucose-RDW hemoglobin index, defined as (glucose in mmol/L + RDW %)/hemoglobin in g/dL. The first glucose, hemoglobin, and RDW values measured between 6 hours before and 24 hours after hospital admission were used. Glucose values were converted to mmol/L in the primary index to reduce the dominance of the glucose scale. Prespecified comparison variables included glucose, RDW, hemoglobin, the glucose/hemoglobin ratio, the hemoglobin/RDW ratio, and the raw mg/dL-based formula (glucose in mg/dL + RDW)/hemoglobin.

Outcome and Covariates

The primary outcome was all-cause in-hospital mortality, defined by hospital discharge disposition during the index hospitalization. Age, sex, ethnicity, diabetes, hypertension, chronic kidney disease, heart failure, atrial fibrillation, cardiogenic shock, creatinine, invasive mechanical ventilation within 24 hours, and vasopressor use within 24 hours were included as candidate covariates. Comorbidities were derived from ICD-9/10 diagnosis codes recorded during the index admission. These code-based constructs were interpreted in the context of contemporary guideline-based disease definitions for chronic kidney disease and atrial fibrillation (17,18). Hypertension and heart failure were interpreted according to current guideline-based disease definitions (19,20).

Anemia was predefined for subgroup analyses as admission hemoglobin below 13.0 g/dL in men and below 12.0 g/dL in women, in line with the current World Health Organization hemoglobin cutoff guideline (21). Early invasive mechanical ventilation and vasopressor use were extracted from ICU event tables within 24 hours of hospital admission. Non-invasive ventilation labels were excluded from the definition of invasive ventilation.

Statistical Analysis

Continuous variables were summarized as medians and interquartile ranges, and categorical variables as counts and percentages. Group comparisons were performed using the Mann-Whitney U test or the Kruskal-Wallis test for continuous variables, and the chi-square test for categorical variables. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

The primary index was analyzed both as a continuous variable and in quartiles. Logistic regression was used for the primary outcome. The unadjusted model included the index alone. Model 1 adjusted for age and sex. Model 2 was adjusted for age, sex, ethnicity, diabetes, hypertension, chronic kidney disease, heart failure, and atrial fibrillation. Model 3, prespecified as the primary adjusted model, further included cardiogenic shock, invasive mechanical ventilation within 24 hours, vasopressor use within 24 hours, and creatinine. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Restricted cubic spline analysis with four knots was used to assess non-linearity.

Receiver operating characteristic analysis was used to compare discrimination across predefined benchmarks. The area under the curve (AUC) was estimated with 95% CIs, and bootstrap-based pairwise comparisons were performed between the new index and each comparator. Prespecified subgroup analyses were performed for diabetes, anemia, chronic kidney disease, cardiogenic shock, and age (<65 or ≥65 years), with interaction terms tested in adjusted models. Multicollinearity was assessed using variance inflation factors, with a threshold below 3 considered acceptable. The events-per-variable ratio was assessed for the primary model. Multiple imputation was not applied because there was no loss of complete cases in the final main-model dataset. Two-sided p-values below 0.05 were considered statistically significant.

Results

Among 5361 adults' first hospital admissions with a primary diagnosis of AMI, 2901 included at least one ICU stay during the same hospitalization. Admission-window glucose was available in 2871 admissions, hemoglobin in 2868, and RDW in 2867. The final cohort consisted of 2861 admissions for which all three exposure components were

available. In-hospital death occurred in 257 patients (9.0%). No duplicate hospital admission rows, impossible time ordering, window violations, or implausible final laboratory values remained after cohort lock (Figure 1).

The admission glucose-RDW hemoglobin index showed a graded relationship with baseline risk. Across quartiles, median age increased from 63.0 years in quartile 1 to 73.0 years in quartile 4, median glucose increased from 110.0 to 213.0 mg/dL, median hemoglobin decreased from 14.7 to 10.4 g/dL, and median RDW increased from 13.1% to 14.5%. In-hospital mortality rose from 1.1% in quartile 1 to 4.6% in quartile 2, 10.6% in quartile 3, and 19.6% in quartile 4. Baseline characteristics across quartiles are shown in Table 1.

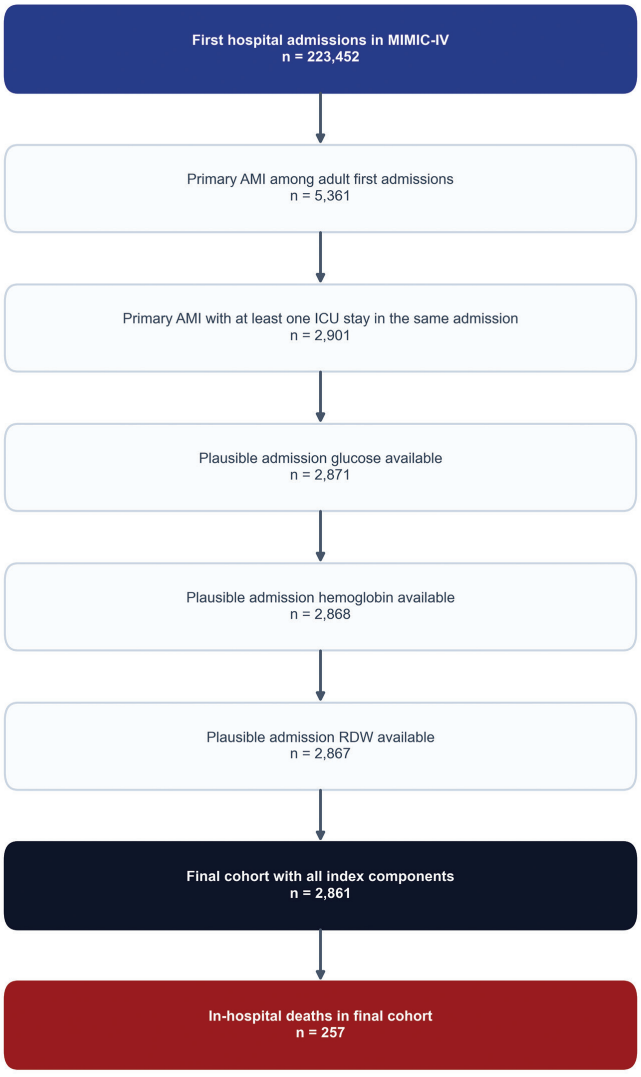

Figure 1. Study flowchart

The figure summarizes cohort construction from the first adult hospital admission to the final analysis cohort with complete admission-window measurements of glucose, hemoglobin, and RDW

RDW: Red cell distribution width, ICU: Intensice care unit, AMI: Acute myocardial infarction, MIMIC-IV: Medical Information Mart for Intensive Care IV

Non-survivors were older and had more adverse admission profiles than survivors. Median glucose was 184.0 mg/dL in non-survivors and 134.0 mg/dL in survivors; median hemoglobin was 11.9 g/dL and 13.0 g/dL; median RDW was 14.1% and 13.5%; and median index was 2.2 and 1.7. Cardiogenic shock, early invasive mechanical ventilation, and early vasopressor use were also more frequent among non-survivors (Table 2).

As a continuous variable, the index was associated with in-hospital mortality in the unadjusted model (OR 2.90, 95% CI 2.44-3.43; p<0.001), in Model 1 (OR 2.74, 95% CI 2.30-3.26; p<0.001), in Model 2 (OR 2.95, 95% CI 2.41-3.60; p<0.001), and in the primary adjusted Model 3 (OR 1.99, 95% CI 1.59-2.51; p<0.001). Quartile analysis showed a similar gradient. Relative to quartile 1, the primary adjusted ORs were 3.03 (95% CI 1.35-6.79; p=0.007) for quartile 2, 5.99 (95% CI 2.75-13.02; p<0.001) for quartile 3, and 9.74 (95% CI 4.45-21.35; p<0.001) for quartile 4. Each one-quartile increase was associated with an OR of 1.93 (95% CI 1.60-2.32; p<0.001). Restricted cubic spline analysis showed a significant overall association and a significant non-linear component (both p<0.001) (Table 3, Figure 2).

The index provided the highest discrimination among the predefined benchmarks, with an AUC of 0.753 (95% CI 0.726-0.780). The corresponding AUCs were 0.732 (95% CI 0.699-0.762) for glucose/hemoglobin ratio, 0.689 (95% CI 0.651-0.723) for glucose alone, 0.659 (95% CI 0.623-0.692) for hemoglobin/RDW ratio, 0.631 (95% CI 0.596-0.666) for hemoglobin, and 0.629 (95% CI 0.590-0.664) for RDW. The AUC advantage of the index over the glucose/hemoglobin ratio was 0.021 (95% CI 0.001-0.042; p=0.041) and over glucose alone was 0.065 (95% CI 0.031-0.097; p<0.001). The association remained directionally consistent across prespecified subgroups, with stronger gradients in patients without anemia, chronic kidney disease, or cardiogenic shock, and in patients younger than 65 years. Interaction p-values were 0.095 for diabetes, <0.001 for anemia, <0.001 for chronic kidney disease, 0.006 for cardiogenic shock, and 0.018 for age. The maximum variance inflation factor in the primary model was 2.43, and the event-per-variable ratio was 19.77 (Table 4, Figure 3). Prespecified subgroup analyses are shown in Figure 4.

Table 1. Baseline characteristics according to quartiles of the admission glucose-RDW hemoglobin index

Characteristic	Q1	Q2	Q3	Q4	p-value
Age, years	63.0 (56.0-69.0)	68.0 (60.0-77.0)	72.0 (63.0-80.0)	73.0 (65.0-81.0)	<0.001
Glucose, mg/dL	110.0 (98.8-126.2)	130.0 (109.0-154.0)	151.0 (122.0-195.0)	213.0 (148.0-309.5)	<0.001
Hemoglobin, g/dL	14.7 (14.0-15.5)	13.2 (12.5-14.1)	12.1 (11.2-13.3)	10.4 (9.3-11.9)	<0.001
RDW, %	13.1 (12.6-13.6)	13.3 (12.9-13.9)	13.7 (13.1-14.6)	14.5 (13.4-16.0)	<0.001
Creatinine, mg/dL	0.9 (0.8-1.1)	0.9 (0.8-1.1)	1.1 (0.8-1.4)	1.3 (0.9-1.9)	<0.001
New index, unitless	1.3 (1.2-1.4)	1.6 (1.5-1.6)	1.9 (1.8-2.0)	2.5 (2.3-2.9)	<0.001
Male sex	653 (91.2)	496 (69.4)	441 (61.7)	407 (56.9)	<0.001
White ethnicity	423 (59.1)	397 (55.5)	421 (58.9)	391 (54.7)	0.213
Diabetes	114 (15.9)	186 (26.0)	303 (42.4)	474 (66.3)	<0.001
Hypertension	479 (66.9)	524 (73.3)	567 (79.3)	586 (82.0)	<0.001
Chronic kidney disease	53 (7.4)	71 (9.9)	171 (23.9)	287 (40.1)	<0.001
Heart failure	156 (21.8)	232 (32.4)	358 (50.1)	439 (61.4)	<0.001
Atrial fibrillation	164 (22.9)	205 (28.7)	266 (37.2)	271 (37.9)	<0.001
Anemia	18 (2.5)	196 (27.4)	424 (59.3)	599 (83.8)	<0.001
Cardiogenic shock	44 (6.1)	76 (10.6)	134 (18.7)	200 (28.0)	<0.001
Invasive mechanical ventilation, first 24 h	67 (9.4)	109 (15.2)	130 (18.2)	173 (24.2)	<0.001
Vasopressor use, first 24 h	64 (8.9)	122 (17.1)	140 (19.6)	182 (25.5)	<0.001
In-hospital mortality	8 (1.1)	33 (4.6)	76 (10.6)	140 (19.6)	<0.001

RDW: Red cell distribution width

Table 2. Baseline characteristics according to in-hospital survival status

Characteristic	Survivors	Non-survivors	p-value
Age, years	68.0 (60.0-77.0)	76.0 (65.0-84.0)	<0.001
Glucose, mg/dL	134.0 (109.0-176.0)	184.0 (135.0-292.0)	<0.001
Hemoglobin, g/dL	13.0 (11.5-14.4)	11.9 (10.2-13.5)	<0.001
RDW, %	13.5 (12.9-14.3)	14.1 (13.3-15.2)	<0.001
Creatinine, mg/dL	1.0 (0.8-1.3)	1.4 (1.1-2.1)	<0.001
New index, unitless	1.7 (1.4-2.0)	2.2 (1.8-2.8)	<0.001
Male sex	1839 (70.6)	158 (61.5)	0.003
White ethnicity	1525 (58.6)	107 (41.6)	<0.001
Diabetes	967 (37.1)	110 (42.8)	0.085
Hypertension	1960 (75.3)	196 (76.3)	0.781
Chronic kidney disease	507 (19.5)	75 (29.2)	<0.001
Heart failure	1044 (40.1)	141 (54.9)	<0.001
Atrial fibrillation	804 (30.9)	102 (39.7)	0.005
Anemia	1078 (41.4)	159 (61.9)	<0.001
Cardiogenic shock	302 (11.6)	152 (59.1)	<0.001
Invasive mechanical ventilation, first 24 h	353 (13.6)	126 (49.0)	<0.001
Vasopressor use, first 24 h	377 (14.5)	131 (51.0)	<0.001

RDW: Red cell distribution width

Table 3. Logistic regression analyses for the admission glucose-RDW hemoglobin index

Analysis	Comparison	OR (95% CI)	p-value
Continuous new index	Unadjusted	2.90 (2.44-3.43)	<0.001
Continuous new index	Model 1	2.74 (2.30-3.26)	<0.001
Continuous new index	Model 2	2.95 (2.41-3.60)	<0.001
Continuous new index	Model 3	1.99 (1.59-2.51)	<0.001
Quartile model	Q2 vs. Q1	3.03 (1.35-6.79)	0.007
Quartile model	Q3 vs. Q1	5.99 (2.75-13.02)	<0.001
Quartile model	Q4 vs. Q1	9.74 (4.45-21.35)	<0.001
Quartile model	Per quartile increase	1.93 (1.60-2.32)	<0.001

RDW: Red cell distribution width, CI: Confidence interval, OR: Odds ratio

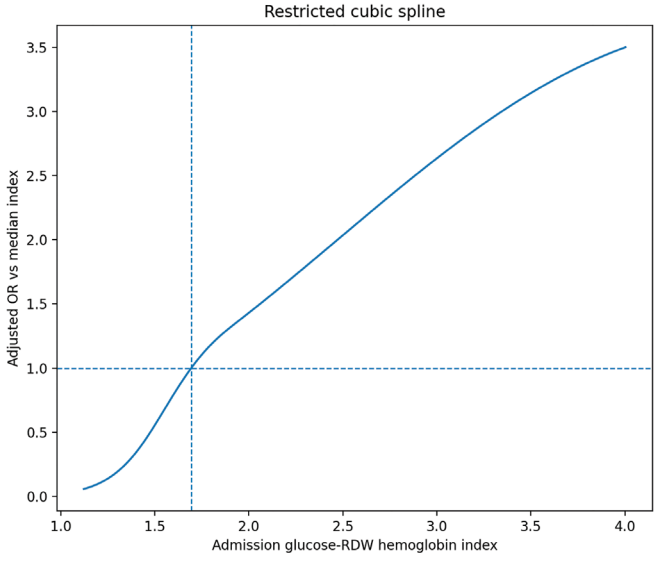

Figure 2. Restricted cubic spline for the admission glucose-RDW hemoglobin index and in-hospital mortality. The solid line shows the adjusted odds ratio from the primary model, and the shaded area indicates the 95% confidence interval

RDW: Red cell distribution width

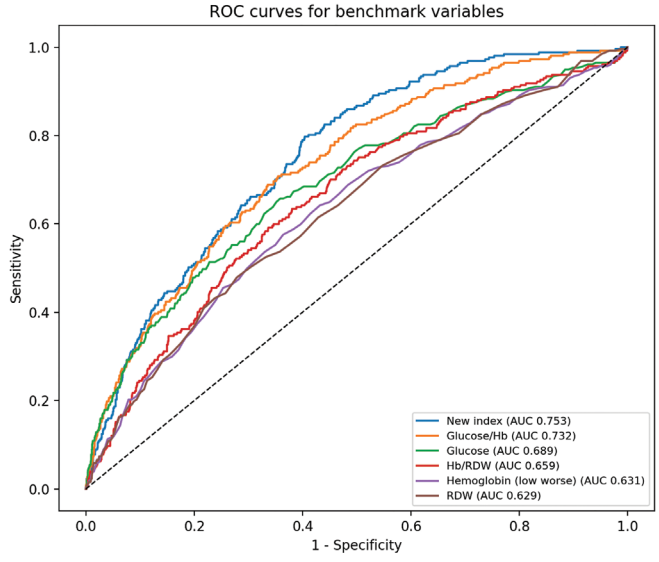

Figure 3. Receiver operating characteristic curves for the admission glucose-RDW hemoglobin index and predefined comparators for in-hospital mortality

RDW: Red cell distribution width, ROC: Receiver operating characteristic, AUC: Area under the curve, Hb: Hemoglobin

Table 4. Discrimination of the admission glucose-RDW hemoglobin index and predefined benchmarks for in-hospital mortality

Marker	AUC (95% CI)	ΔAUC vs. new index (95% CI)	p-value
New index	0.753 (0.726-0.780)	Reference	
Glucose/hemoglobin ratio	0.732 (0.699-0.762)	0.021 (0.001-0.042)	0.041
Glucose	0.689 (0.651-0.723)	0.065 (0.031-0.097)	<0.001
Hemoglobin/RDW ratio	0.659 (0.623-0.692)	0.094 (0.064-0.125)	<0.001
Hemoglobin	0.631 (0.596-0.666)	0.121 (0.091-0.151)	<0.001
RDW	0.629 (0.590-0.664)	0.125 (0.086-0.165)	<0.001

RDW: Red cell distribution width, CI: Confidence interval, AUC: Area under the curve

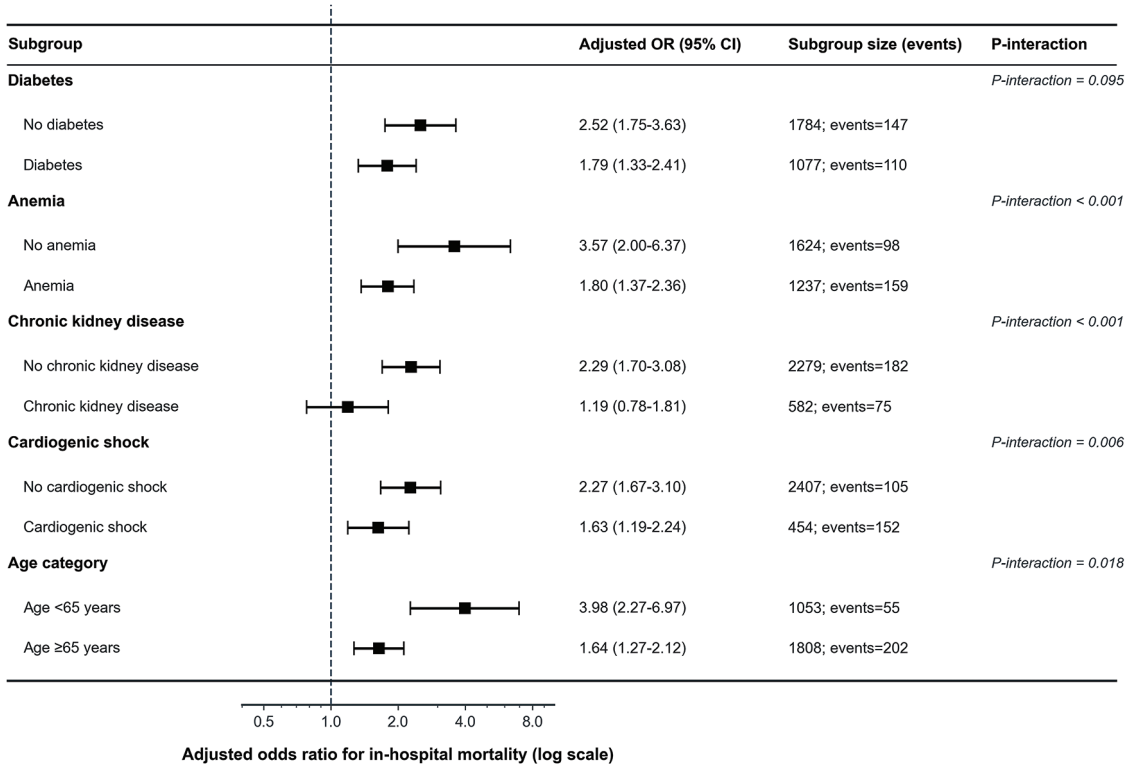

Figure 4. Forest plot of prespecified subgroup analyses for the admission glucose-RDW hemoglobin index and in-hospital mortality. Point estimates represent adjusted odds ratios with 95% confidence intervals, and interaction p-values are shown for each subgroup

RDW: Red cell distribution width, CI: Confidence interval, OR: Odds ratio

Discussion

A higher admission glucose-RDW hemoglobin index was associated with higher in-hospital mortality in critically ill patients with AMI. The association persisted after adjustment for demographics, comorbidities, cardiogenic shock, early organ support, and creatinine; a clear dose-response gradient was evident across quartiles. The index also exhibited a non-linear risk pattern and had the highest AUC among the prespecified admission benchmarks.

The glucose component of the index is clinically plausible. Admission hyperglycemia has repeatedly been associated with adverse short-term outcomes after AMI, including in patients without previously recognized diabetes (3,4). Glucose alone, however, captures only one part of the early physiologic response to infarction. Prior work on stress-based glycemic ratios in intensive cardiac care AMI cohorts also supports the relevance of acute metabolic context, but those measures require historical glycemic data and therefore address a different clinical question (6,22). In the present cohort, glucose alone discriminated mortality less well than did the composite index, which suggests that combining metabolic stress with hematologic reserve may improve admission-level risk characterization.

The RDW and hemoglobin components are also consistent with prior AMI literature. RDW has been associated with mortality after myocardial infarction, while lower hemoglobin has been linked to worse ischemic outcomes and reduced physiologic reserve in acute coronary syndromes (7,23). The present results are consistent with that framework. The index rose as hemoglobin fell and RDW increased, and the mortality gradient across quartiles paralleled these shifts. This pattern supports the view that early erythrocyte heterogeneity and reduced oxygen-carrying capacity provide prognostic information beyond glucose levels alone.

The comparison with other simple ratios is clinically relevant because the study was not designed to promote a black-box predictor. The new index performed better than the glucose/hemoglobin and hemoglobin/RDW ratios, while the raw mg/dL-based formula showed weaker discrimination than the primary mmol/L-based formula. That result suggests that the observed signal was not

explained solely by rescaling glucose or by reproducing a known two-component ratio (11,12). Related AMI studies have reported prognostic value for other simple admission blood-cell ratios, including mean platelet volume-based ratios in Bagcilar Medical Bulletin and neutrophil-to-lymphocyte ratio in patients with stent thrombosis and high mortality after AMI (24,25). Prior work with erythrocyte-based composite markers supports the relevance of this line of inquiry, but the present analysis indicates only a modest incremental gain rather than a categorical shift in discrimination (26).

Findings from subgroup analyses refine the clinical signal. The association was preserved in patients with and without diabetes, and the interaction test did not support strong effect modification by diabetes. In contrast, weaker gradients in patients with anemia, chronic kidney disease, and cardiogenic shock suggest that advanced baseline hematologic or hemodynamic derangement may partially compress the discriminatory range of the index. The stronger gradient in younger patients may indicate that competing risks associated with age-related frailty narrow the relative impact of admission laboratory perturbations in older ICU-treated AMI patients.

The study has several strengths. The cohort was anchored to hospital admission rather than ICU admission, thereby aligning exposure measurement with the period during which glucose, hemoglobin, and RDW are usually first obtained. The final cohort had no complete-case loss for the primary model; data integrity checks were clean after cohort lock; invasive ventilation extraction excluded non-invasive ventilation labels. The analysis also combined association testing, non-linearity assessment, discrimination benchmarking, multicollinearity checks, and prespecified subgroup interaction testing in one coherent framework.

Study Limitations

Several limitations should be considered. The study used a single-center retrospective critical care database from the United States, which may limit the the generalizability of the findings. AMI and comorbidities were defined using administrative and electronic record proxies rather than by adjudicated clinical review. Infarct type, reperfusion strategy, left ventricular function, and transfusion exposure were not incorporated into the primary adjusted model. The gain in discrimination over the glucose/hemoglobin ratio was statistically significant, but small. External validation in contemporary multicenter AMI-ICU cohorts and head-to-head comparisons against established admission risk tools are the next steps before clinical use.

Conclusion

In critically ill adults admitted with AMI, a higher admission glucose-RDW hemoglobin index was associated with increased in-hospital mortality and provided modest incremental discrimination beyond glucose and simple component-based ratios.

Ethics

Ethics Committee Approval: Ethics approval was obtained from the Bezmialem Vakıf University Non-Interventional Clinical Research Ethics Committee (meeting no: 5, decision no: 1, March 31, 2026).

Informed Consent: The requirement for informed consent was waived because the study used a deidentified critical care database.

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For transparency, the authors note that an artificial intelligence–assisted language model (ChatGPT, OpenAI) was utilized to support language correction. This assistance was limited to linguistic refinement; all scientific content, critical analysis, and final editorial decisions were made exclusively by the authors.

Footnotes

Authorship Contributions

Concept: H.B.İ., Design: H.B.İ., S.B., S.T.Y., Data Co llection or Processing: H.B.İ., Analysis or Interpretation: H.B.İ., S.B., S.T.Y., Literature Search: H.B.İ., S.B., S.T.Y., Writing: H.B.İ., S.B.

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