ISSN: 2320-9267

Indian Journal of Pharmaceutical and Biological Research (IJPBR)

Journal homepage: www.ijpbr.in

RESEARCH ARTICLE

A Prospective Observational Study Of Association Of Stress Hyperglycaemia Ratio (Shr) And The Clinical Outcomes In Critically Ill Patients

Boddu Jyotirmayi[1*], Gandhi Parise[1], V.C.Srinivas Reddy[1], Rajanish Chandra[2]

ABSTRACT

Background: Stress hyperglycaemia ratio (SHR), which adjusts admission blood glucose for chronic glycaemic status using HbA1c, is a more reliable marker of acute metabolic stress than admission blood glucose alone. Prospective evidence from heterogeneous critically ill patients in the Indian ICU setting remains limited.

Objectives: To evaluate the association between SHR and clinical outcomes, including in-hospital mortality, ICU length of stay, mechanical ventilation, vasopressor requirement in critically ill adults.

Methods: A prospective observational study was conducted amongcritically ill adults in medical ICU of a tertiary care hospital. SHR was calculated using admission blood glucose and HbA1c. Clinical outcomes included mortality, ICU length of stay, mechanical ventilation, vasopressor requirement, and APACHE score. Statistical significance was defined as $p<0.05$.

Results: The mean age was 58.5±12 years. Overall in-hospital mortality was 23.5%. Mean SHR was significantly higher among non-survivors than survivors (1.46 vs. 1.10; $p<0.001$). Mortality increased progressively as SHR increases. Patients requiring mechanical ventilation and vasopressor support also demonstrated higher SHR values.

Conclusions: SHR is a simple and readily available biomarker for early risk stratification in critically ill patients. Routine assessment of SHR may improve prognostication and guide early clinical decision-making.

Keywords: Stress hyperglycaemia ratio; Critical illness; Intensive care unit; Mortality; Mechanical ventilation; APACHE score; Prognostic biomarker.

Indian J. Pharm. Biol. Res. (2026): https://doi.org/10.30750/ijpbr.14.3.49

INTRODUCTION

Stress hyperglycaemia is an adaptive metabolic response to acute illness, driven by neuroendocrine activation, inflammatory mediators, and transient insulin resistance. While initially protective, persistent stress hyperglycaemia is linked to adverse outcomes [1,2]. Admission blood glucose has traditionally been used as a marker of severity, but it is confounded by chronic glycaemic status, particularly diabetes, limiting prognostic accuracy [1,3].

To address this, Roberts et al. (2015) introduced the Stress Hyperglycaemia Ratio (SHR), which relates admission glucose to HbA1cderived estimated average glucose, thereby quantifying relative rather than absolute hyperglycaemia [1]. By accounting for chronic glycaemic status, SHR provides a more accurate estimate of acute metabolic stress and has emerged as a superior prognostic indicator compared with admission glucose alone [1,2].

Growing evidence shows that elevated SHR is associated with increased mortality and adverse outcomes across diverse acute illnesses, including acute coronary syndrome, heart failure, ischemic stroke, sepsis, pneumonia, and critical illness requiring intensive care [2–5]. However, most available studies are retrospective, diseasespecific, or conducted outside India, limiting generalizability. Considering the high burden of critical illness and the prevalence of diabetes in the Indian population, prospective evaluation of SHR in heterogeneous ICU cohorts is needed.

[1]MD-Associate Professor, General Medicine, Government Siddhartha Medical College, Vijayawada, Andra Pradesh, India

[2]MBBS- Medical Intern, General Medicine, Government Siddhartha Medical College, Vijayawada , Andra Pradesh, India

Corresponding Author: Boddu Jyotirmayi-Associate Professor, General Medicine, Government Siddhartha Medical College, Vijayawada, Andra Pradesh, India Email: drboddudgo2001@yahoo.com

How to cite this article: Jyotirmayi B, Parise G, ReddyVCS, Chandra R. A Prospective Observational Study Of Association Of Stress Hyperglycaemia Ratio (Shr) And The Clinical Outcomes In Critically Ill Patients. Indian J. Pharm. Biol. Res. 2026;14(3):312-317.

Source of support: Nil

Conflict of interest: None.

Received: 05/06/2026 **Revised:** 12/07/2026 **Accepted:** 20/07/2026 **Published:** 12/08/2026

Therefore, this prospective observational study was undertaken to assess the association between SHR and clinical outcomes among critically ill adults admitted to a tertiary care teaching hospital ICU.

METHODS

Missing

Study Design

This prospective observational study was conducted in the Medical Intensive Care Unit (MICU), Department of General Medicine, Government General Hospital, Vijayawada, affiliated with Dr. N.T.R. University of Health Sciences, Andhra Pradesh, India. The study spanned two months following approval from the Institutional Ethics Committee (IEC Reference No. IECSMCGGH/2025/AP/224). Written informed consent was obtained from all participants or their legal representatives, and the study adhered to the Declaration of Helsinki.

Study Population

Adults (≥18 years) admitted to the MICU during the study period were screened. Eightyfive consecutive critically ill patients meeting inclusion criteria were enrolled using convenience sampling.

Eligibility Criteria

Inclusion: age ≥18 years, MICU admission, availability of admission glucose and HbA1c, and informed consent. Exclusion: ICU stay <24 hours, pregnancy/postpartum, prior corticosteroid therapy, diabetic ketoacidosis, hyperosmolar hyperglycaemic state, chronic kidney disease stage 3–5, chronic liver disease, severe anaemia (Hb <6 g/dL), and haemoglobinopathies.

Data Collection

Baseline demographics (age, sex, BMI, primary diagnosis, comorbidities) were recorded. Admission labs included complete blood count, renal and liver function, Creactive protein, electrolytes, glucose, and HbA1c. ICU course variables included mechanical ventilation, vasopressor therapy, ICU length of stay, APACHE II score, and hospital outcome (discharge or death).

Stress Hyperglycaemia Ratio (SHR)

SHR was calculated as

- Estimated Average Glucose (eAG, mg/dL)=(28.7×HbA1c)−46.7
- SHR=Admission Glucose÷ eAGOutcomes were compared across SHR values.

Outcome Measures

Primary outcome: inhospital mortality. Secondary outcomes: ICU length of stay, requirement/duration of mechanical ventilation, vasopressor use, and illness severity (APACHE II score).

Statistical Anal2ysis

Data were analysed using IBM SPSS Statistics v27. Continuous variables were expressed as mean ± SD or median (IQR); categorical variables as frequencies and percentages. Group comparisons used appropriate statistical tests. Correlation analysis assessed associations between SHR and morbidity indicators. Logistic regression identified independent predictors of mortality. A twotailed p <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

Eightyfive critically ill adults were enrolled (mean age 54.5 ± 13.4 years; 72.9% male; mean BMI 25.9 ± 3.8 kg/m²). The mean APACHE II score was 18.0 ± 8.7. Admission glucose averaged 177.3 ± 81.9 mg/dL, HbA1c 6.77 ± 1.44%, and estimated average glucose 153.4 ± 47.8 mg/dL. The overall mean SHR was 1.18 ± 0.39 (Table 1).

Outcomes

Of 85 patients, 65 (76.5%) were discharged and 20 (23.5%) died. Nonsurvivors had significantly higher SHR (1.46 vs 1.10, p<0.001), indicating more pronounced stress hyperglycaemia (Table 2)

Stress Hyperglycemia and ICU Course

ICU Length of Stay

Half of patients (50.6%) stayed <5 days, with mean SHR 1.08. SHR rose progressively with longer stays: 1.20 (5–10 days), 1.31 (10–15 days), and 1.47 (>15 days). This

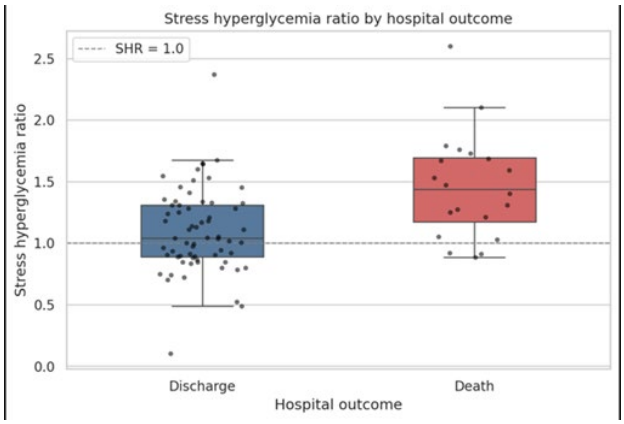

Figure 1:

Table 1: Baseline descriptive statistics

Variable	*Mean ± SD*	*Median (Range)*
Age (years)	54.54 ± 13.42	56 (22–87)
BMI (kg/m²)	25.89 ± 3.83	25.96 (15.99–35.06)
APACHE II score	17.99 ± 8.65	16 (4–42)
Admission blood glucose (mg/dL)	177.29 ± 81.85	152 (68–523)
HbA1c (%)	6.77 ± 1.44	6.5 (3.1–12.7)
Estimated average blood glucose (mg/dL)	153.42 ± 47.79	143 (42–404)
Stress Hyperglycemia Ratio (SHR)	1.18 ± 0.39	1.13 (0.10–2.60)
ICU length of stay (days)	6.79 ± 4.06	5 (1–30)
Duration of mechanical ventilation (days)	1.08 ± 1.96	0 (0–7)
Vasopressor duration (days)	0.79 ± 1.74	0 (0–11)

Table 2: Outcome distribution

Outcome	*n*	*%*
Discharge	65	76.5
Death	20	23.5

trend was significant (p=0.0022), linking prolonged ICU admission to higher SHR(figure 2).

Mechanical Ventilation

Twentyfour patients (28.2%) required invasive ventilation. Their mean SHR was 1.32 compared to 1.05 in nonventilated patients, with maximum SHR reaching 2.60. Thus, ventilated patients exhibited significantly greater stress hyperglycaemia (figure 3).

Vasopressor Use

Twenty patients (23.5%) required vasopressors. Their mean SHR was 1.28 versus 1.05 in those not requiring support. Maximum SHR in this group was 2.60, reflecting extreme stress in patients with hemodynamic compromise (figure 4).

Correlations of SHR and Severity Indicators

Spearman analysis showed SHR correlated strongly with duration of mechanical ventilation (r=0.49, p<0.000001) and moderately with ICU stay (r=0.25, p=0.0197). Vasopressor duration showed no significant correlation (r=0.17, p=0.11). Overall, higher SHR accompanied prolonged ICU care and intensive life support (Table 3).

Survivors versus Non-survivors

Nonsurvivors were older (60.4 ± 14.3 vs 52.8 ± 14.0 years, p=0.044) and had higher APACHE II scores (28.9 ± 7.2 vs 15.1 ± 7.1, p<0.001). BMI, admission glucose, and HbA1c did not differ significantly. SHR was markedly higher in nonsurvivors (1.46 ± 0.43 vs 1.11 ± 0.42, p=0.003), confirming its prognostic value (Table 4).

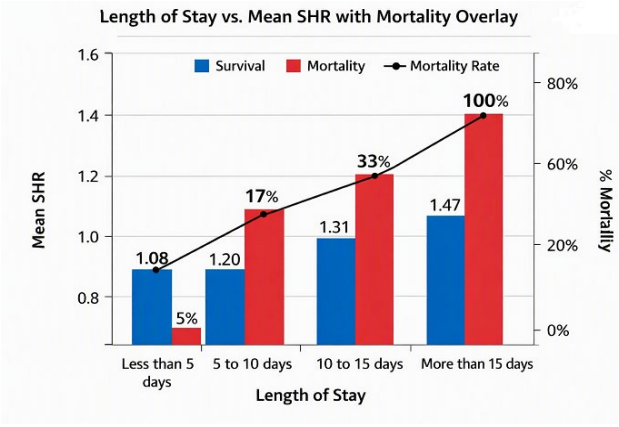

Figure 2:

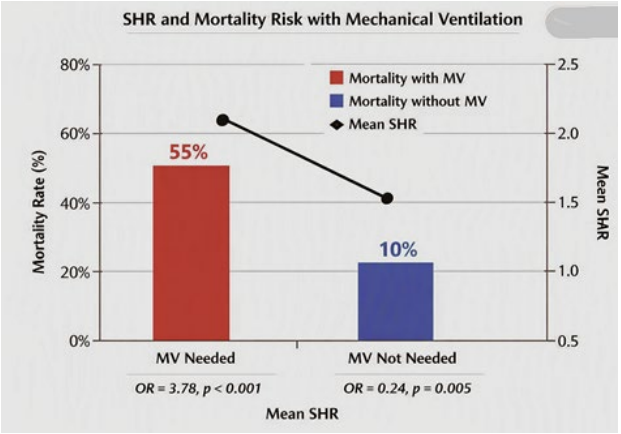

Figure 3:

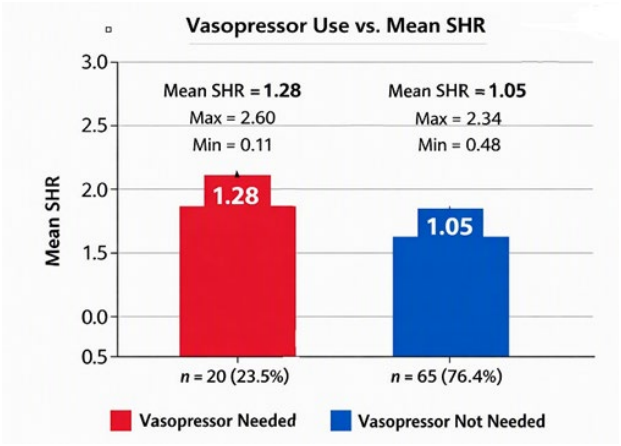

Figure 4:

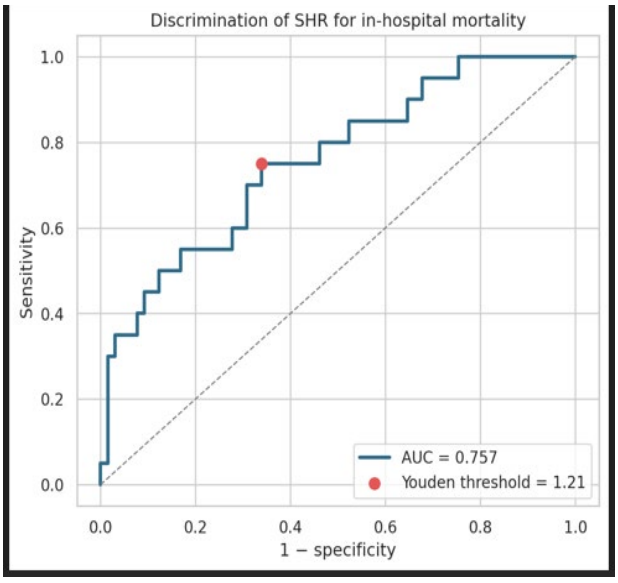

Figure 5:

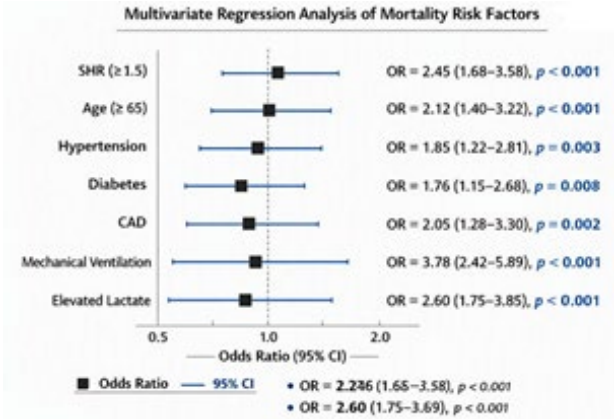

Figure 6:

Table 3: Spearman correlations between SHR and morbidity factors

VARIABLES	*Spearmans(r)*	*p value*	***Significance***
Duration of mechanical ventilator use	0.49	p<0.000001	Significant
Duration of Vasopressoruse	0.17	0.11	Notsignificant
Stress hyperglycaemia ratio	0.37	0.00037	Significant
DurationofICU stay	0.25	0.0197	Significant

Table 4: Baseline characteristics by outcome

Variable	*Overall (N=85)*	*Survivors (n=65)*	*Non-survivors (n=20)*	*p value*
Age (years)	54.5 ± 14.3	52.8 ± 14.0	60.4 ± 14.3	0.044
Male sex, n (%)	62 (72.9%)	48 (73.8%)	14 (70.0%)	0.820
BMI (kg/ m^2)	25.9 ± 3.8	25.8 ±4.1	26.4 ± 2.7	0.473
Admission glucose (mg/dL)	180.6 ± 90.0	171.9 ± 92.4	211.7 ± 75.1	0.054
HbA1c (%)	6.81 ± 1.62	6.81 ± 1.69	6.82 ± 1.38	0.971
SHR	1.19 ± 0.44	1.11 ± 0.42	1.46 ± N0.43	0.003
APACHE II score	18.16 ± 9.09	15.14 ± 7.08	28.85 ± 7.23	<0.001

Abbreviations

APACHE II, Acute Physiology and Chronic Health Evaluation II; HbA1c, glycated hemoglobin; SHR, stress hyperglycemia ratio; ICU, intensive care unit.

Prognostic Value of SHR

ROC analysis demonstrated fair discriminatory ability for mortality (AUC 0.73, p<0.01). SHR >1.5 was strongly associated with death, while SHR <1.0 was more common among survivors. Thus, SHR at ICU admission can serve as an early stratification tool.

Multivariate Predictors of Mortality

Logistic regression confirmed SHR >1.5 as an independent predictor (OR 2.45, p<0.001). Mechanical ventilation was the strongest predictor (OR 3.78, p<0.001). Advanced age

(≥65 years), coronary artery disease, and hypertension each doubled mortality risk (OR ≈2.0, p<0.05). Diabetes and elevated lactate contributed modestly. Collectively, these findings highlight that elevated metabolic stress, reflected by high SHR, in combination with critical illness factors, drives poor ICU outcomes.

DISCUSSION

Stressinduced hyperglycaemia is a recognized metabolic response to critical illness and has consistently been linked with adverse outcomes. In our cohort, the Stress Hyperglycaemia Ratio (SHR) showed a clear dosedependent association with inhospital mortality and illness severity. Elevated SHR correlated with prolonged ICU stay, greater need for mechanical ventilation and vasopressor support, and higher APACHE II scores, reinforcing its role as a marker of acute metabolic stress relative to chronic glycaemic status.

Our findings align with recent international studies. Le Li and Yan (2024) described a Ushaped association between SHR and mortality in ICU patients [6,7], confirming SHR as an independent prognostic marker, though morbidity outcomes were not assessed. Chen et al. (2025) reported a linear increase in ICU and hospital mortality with rising SHR in cerebrovascular disease, independent of severity scores [8]. Similarly, Mondal et al. (2022) demonstrated that SHR ≥1.14 predicted higher mortality, ICU admission, mechanical ventilation, sepsis, and organ dysfunction in Indian COVID19 patients, outperforming admission glucose alone [9]. Our results extend these observations to a heterogeneous medical ICU population.

In our study, SHR >1.5 independently predicted mortality (OR ≈2.45), alongside mechanical ventilation (OR ≈3.78), advanced age, and comorbidities such as coronary artery disease and hypertension. The biological plausibility of these associations is strong: acute stress hyperglycaemia promotes inflammatory cytokine release, endothelial dysfunction, oxidative stress, coagulation abnormalities, and microvascular thrombosis, all contributing to organ failure. By incorporating HbA1c, SHR distinguishes acute stressinduced hyperglycaemia from chronic hyperglycaemia, offering superior prognostic accuracy compared with admission glucose alone.

Importantly, SHR demonstrated fair discriminatory ability (AUC 0.73), suggesting its utility as an early stratification tool. Values >1.5 were strongly associated with death, while values <1.0 were more common among survivors. This supports routine SHR assessment at ICU admission to identify highrisk patients and guide early interventions.

Overall, our findings reinforce SHR as a practical and readily available biomarker for risk stratification in critically ill patients. Consistent with prior evidence, higher SHR was associated with increased mortality and morbidity, providing better prognostic information than absolute glucose. Larger multicentre studies with diverse ICU populations and longterm followup are warranted to validate optimal SHR thresholds and explore whether SHRguided interventions can improve outcomes.

CONCLUSION

Stress hyperglycaemia ratio independently predicts ICU mortality, offering superior risk stratification compared to glucose or HbA1c. Validation in multicentre studies is needed to define thresholds and guide interventions.

ACKNOWLEDGEMENTS

Affiliated To Dr NTR University of Health Sciences, Vijayawada, Andhra Pradesh.

REFERENCES

1. Roberts GW, Quinn SJ, Valentine N, Alhawassi T, O'Dea H, Stranks SN, et al. Relative hyperglycemia, a marker of critical illness: introducing the stress hyperglycemia ratio. J Clin Endocrinol Metab. 2015;100(12):4490–7.
2. Tan MY, Zhang YJ, Zhu SX, Wu S, Zhang P, Gao M. The prognostic significance of stress hyperglycemia ratio in evaluating allcause and cardiovascular mortality risk among individuals across stages 0–3 of cardiovascularkidneymetabolic syndrome: evidence from two cohort studies. Cardiovasc Diabetol. 2025 Mar 24;24(1):137.
3. Ding L, Zhang H, Dai C, Zhang A, Yu F, Mi L, et al. The prognostic value of the stress hyperglycemia ratio for allcause and cardiovascular mortality in patients with diabetes or prediabetes: insights from NHANES 2005–2018. Cardiovasc Diabetol. 2024 Feb 28;23(1):84.
4. Liu J, Zhou Y, Huang H, Liu R, Kang Y, Zhu T, et al. Impact of stress hyperglycemia ratio on mortality in patients with critical acute myocardial infarction: insight from American MIMICIV and the Chinese CINII study. Cardiovasc Diabetol. 2023 Oct 21;22(1):281.
5. Cheng S, Shen H, Han Y, Han S, Lu Y. Association between stress hyperglycemia ratio index and allcause mortality in critically ill patients with atrial fibrillation: a retrospective study using the MIMICIV database. Cardiovasc Diabetol. 2024 Oct 14;23(1):363.
6. Li L, Ding L, Zheng L, Wu L, Hu Z, Liu L, Zhang Z, Zhou L, Yao Y. U-shaped association between stress hyperglycemia ratio and risk of all-cause mortality in cardiac ICU. Diabetes Metab Syndr. 2024 Jan;18(1):102932.
7. Yan F, Chen X, Quan X, Wang L, Wei X, Zhu J. Association between the stress hyperglycemia ratio and 28day allcause

mortality in critically ill patients with sepsis: a retrospective cohort study and predictive model establishment based on machine learning. Cardiovasc Diabetol. 2024;23:163.

8. Chen Y, Xu J, He F, Huang A, Wang J, Liu B, Wei Q. Assessment of stress hyperglycemia ratio to predict all-cause mortality in patients with critical cerebrovascular disease: a retrospective cohort study from the MIMIC-IV database. Cardiovasc Diabetol. 2025 Feb 7;24(1):58.
9. Mondal S, DasGupta R, Lodh M, Garai R, Choudhury B, Hazra AK, et al. Stress hyperglycemia ratio, rather than admission blood glucose, predicts inhospital mortality and adverse outcomes in moderatetosevere COVID19 patients, irrespective of preexisting glycemic status. Diabetes Res Clin Pract. 2022 Aug;190:109974.
10. Yang J, Zheng Y, Li C, Gao J, Meng X, Zhang K, et al. The impact of the stress hyperglycemia ratio on shortterm and longterm poor prognosis in patients with acute coronary syndrome: insight from a large cohort study in Asia. Diabetes Care. 2022;45(4):947–56. doi:10.2337/dc21-1526
11. He HM, Zheng SW, Xie YY, Wang Z, Jiao SQ, Yang FR, et al. Simultaneous assessment of stress hyperglycemia ratio and glycemic variability to predict mortality in patients with coronary artery disease: a retrospective cohort study from the MIMIC IV database. Cardiovasc Diabetol. 2024 Feb 9;23(1):61.
12. Yang J, Zheng Y, Li C, Gao J, Meng X, Zhang K, Wang W, Yang C, Shao C, Tang Y-D.The impact of the stress hyperglycemia ratio on short-term and long-term poor prognosis in patients with acute coronary syndrome: Insight from a large cohort study in Asia.Diabetes Care. 2022;45(4):947-956.
13. Zhang C, Shen H-C, Wang L-R, Ning M, Chen Y, Wei S, Guo T-T, Hu K, Liu Y-W.Relationship between stress hyperglycemia ratio and all-cause mortality in critically ill patients: results from the MIMIC-IV database.Front Endocrinol (Lausanne). 2023;14:1111026.
14. Wang F, Guo Y, Tang Y, Zhao S, Xuan K, Mao Z, Lu R, Hou R, Zhu X.Combined assessment of stress hyperglycemia ratio and glycemic variability to predict all-cause mortality in critically ill patients with atherosclerotic cardiovascular diseases across different glucose metabolic states: an observational cohort study with machine learning.Cardiovasc Diabetol. 2025;24:199.