

Comparative Evaluation of NEWS2, qSOFA and SOFA Scores in Predicting In Hospital Mortality among Patients with Sepsis

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ABSTRACT

Background: Early risk stratification is important for identifying patients with sepsis at increased risk of mortality. This study compared NEWS2, qSOFA, and SOFA for predicting in-hospital mortality. **Methods:** This prospective observational study included 150 adult patients with sepsis. NEWS2, qSOFA, and SOFA were calculated at admission, and patients were followed until discharge or death. Predictive performance was assessed using ROC analysis. **Results:** Of 150 patients, 32 (21.3%) died. Non-survivors had significantly higher NEWS2 (9.1 ± 2.3 vs. 5.8 ± 2.1), qSOFA (2.0 ± 0.7 vs. 1.1 ± 0.7), and SOFA (10.3 ± 3.4 vs. 5.2 ± 2.6) scores than survivors (all $p < 0.001$). SOFA showed the highest AUROC (0.88), followed by NEWS2 (0.82) and qSOFA (0.74). SOFA ≥ 8 demonstrated 84.4% sensitivity and 81.4% specificity, while NEWS2 ≥ 7 showed 81.3% sensitivity and 72.0% specificity. **Conclusion:** SOFA demonstrated the best prediction of in-hospital mortality. NEWS2 also showed good discriminatory performance and may be useful for rapid bedside risk stratification in patients with sepsis.

Keywords: Sepsis; NEWS2; qSOFA; SOFA; mortality; risk stratification.

INTRODUCTION

Sepsis is a life-threatening clinical syndrome characterized by acute organ dysfunction resulting from a dysregulated host response to infection. It remains a major cause of morbidity, intensive care unit (ICU) admission, and mortality worldwide. Globally, an estimated 48.9 million cases of sepsis and 11 million sepsis-related deaths occur annually, accounting for approximately one-fifth of all deaths [1]. Despite advances in antimicrobial therapy, hemodynamic resuscitation, organ support, and critical care, mortality remains substantial. The rapid and heterogeneous clinical course of sepsis makes early recognition, severity assessment, and risk stratification essential for improving outcomes [2]. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) defined sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection [3]. Organ dysfunction is represented by an

acute increase of ≥ 2 points in the Sequential Organ Failure Assessment (SOFA) score. SOFA evaluates six organ systems—respiratory, cardiovascular, hepatic, coagulation, renal, and neurological—and provides a comprehensive assessment of organ dysfunction [3,4]. Higher SOFA scores have been associated with an increased risk of in-hospital mortality among critically ill patients with suspected infection [5]. However, its requirement for multiple clinical and laboratory parameters may limit its immediate use for rapid bedside assessment. The quick Sequential Organ Failure Assessment (qSOFA) was proposed as a simpler bedside tool for identifying patients with suspected infection who are at increased risk of adverse outcomes. It comprises three variables: respiratory rate ≥ 22 breaths/min, systolic blood pressure ≤ 100 mmHg, and altered mental status [4]. Although qSOFA is simple and does not require laboratory investigations, studies have raised concerns regarding its relatively low sensitivity for identifying

high-risk patients [6,7]. The National Early Warning Score 2 (NEWS2), updated by the Royal College of Physicians in 2017, was developed for early recognition of clinical deterioration [8]. It incorporates respiratory rate, oxygen saturation, supplemental oxygen requirement, systolic blood pressure, pulse rate, temperature, and level of consciousness or new confusion. As these parameters are readily available during initial assessment, NEWS2 allows rapid physiological risk assessment without awaiting laboratory investigations [8]. Several studies have compared these scoring systems in patients with suspected infection or sepsis. Brink et al. reported better discrimination with NEWS than qSOFA for 30-day mortality, with AUROC values of 0.779 and 0.697, respectively [9]. Mellhammar et al. [13] similarly demonstrated superior performance of NEWS2 over qSOFA for identifying sepsis-associated organ dysfunction and adverse outcomes [10]. Oduncu et al. reported AUROCs of 0.772 for NEWS and 0.758 for qSOFA for mortality prediction [11]. In an Indian prospective study of 373 patients with sepsis, Verma et al. [12] found that NEWS2 predicted mortality better than qSOFA, with AUROCs of 0.781 and 0.729, respectively [12]. NEWS2, qSOFA, and SOFA assess different dimensions of illness severity: NEWS2 reflects physiological deterioration, qSOFA provides rapid bedside risk assessment, whereas SOFA quantifies established multiorgan dysfunction. Although NEWS2 and qSOFA have been extensively compared, relatively fewer studies have simultaneously evaluated all three scores for predicting in-hospital mortality. A direct comparison may help identify a practical and accurate approach for early triage, closer monitoring, timely escalation of care, and appropriate allocation of critical-care resources. Therefore, the present study aimed to comparatively evaluate NEWS2, qSOFA, and SOFA scores for predicting in-hospital mortality among patients with sepsis and to determine their relative prognostic performance for early risk stratification.

MATERIALS AND METHODS

This was a prospective observational study conducted among patients with sepsis admitted to the department of medicine at a tertiary care hospital.

Study Population

Adult patients aged ≥ 18 years with suspected or confirmed infection fulfilling the Sepsis-3 criteria for sepsis were included. A total of 150 eligible patients were enrolled consecutively during the study period.

Inclusion Criteria

Patients aged ≥ 18 years with suspected or confirmed infection fulfilling Sepsis-3 criteria and having adequate

clinical and laboratory data for calculation of NEWS2, qSOFA, and SOFA scores were included.

Exclusion Criteria

Patients aged < 18 years, pregnant patients, patients transferred after prolonged treatment elsewhere, those with incomplete data for score calculation, and patients whose final hospital outcome could not be determined were excluded.

Data Collection

Demographic characteristics, comorbidities, source of infection, vital signs, Glasgow Coma Scale (GCS), oxygen requirement, and relevant laboratory parameters were recorded at initial assessment. NEWS2, qSOFA, and SOFA scores were calculated for every patient using admission parameters.

Assessment of Scores

NEWS2 was calculated using respiratory rate, oxygen saturation, supplemental oxygen requirement, systolic blood pressure, pulse rate, temperature, and level of consciousness/new confusion. qSOFA was calculated using respiratory rate ≥ 22 breaths/min, systolic blood pressure ≤ 100 mmHg, and altered mental status. SOFA was calculated from respiratory, coagulation, hepatic, cardiovascular, neurological, and renal parameters.

Outcome Assessment

The primary outcome was in-hospital mortality. Patients were followed until discharge or death and categorized as survivors and non-survivors. NEWS2, qSOFA, and SOFA scores were compared between these groups.

Statistical Analysis

Continuous variables were presented as mean $\pm$ SD or median (IQR), and categorical variables as frequency and percentage was done by SPSS.26. Survivors and non-survivors were compared using the independent t-test or Mann-Whitney U test for continuous variables and Chi-square or Fisher's exact test for categorical variables. The predictive performance of NEWS2, qSOFA, and SOFA for in-hospital mortality was evaluated using ROC curves and AUROC with 95% confidence intervals. Optimal cut-offs were determined using the Youden index, and sensitivity, specificity, PPV, NPV, and accuracy were calculated. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 150 patients were included, of whom 118 (78.7%) survived and 32 (21.3%) died during hospitalization. Non-survivors were significantly older than survivors (66.7 ± 13.9 vs. 56.4 ± 14.8 years; $p < 0.001$), while sex, comorbidities, and source of

infection were comparable between the groups (Table 1). Non-survivors had significantly higher respiratory and heart rates and lower systolic blood pressure and SpO₂ (all $p < 0.001$). They also had lower GCS scores and platelet counts and higher serum creatinine and bilirubin levels (Table 2). NEWS2, qSOFA, and SOFA scores were significantly higher among non-survivors than survivors (9.1 ± 2.3 vs. 5.8 ± 2.1 ; 2.0 ± 0.7 vs. 1.1 ± 0.7 ; and 10.3 ± 3.4 vs. 5.2 ± 2.6 , respectively; all $p < 0.001$) (Table 3). ROC analysis showed that SOFA had the highest discriminatory ability for in-hospital mortality (AUROC

0.88, 95% CI: 0.82–0.94), followed by NEWS2 (0.82, 95% CI: 0.75–0.89) and qSOFA (0.74, 95% CI: 0.66–0.82) (Table 4; Figure 1). At optimal cut-offs, SOFA ≥ 8 demonstrated the highest accuracy (82.0%) and NPV (95.0%), compared with NEWS2 ≥ 7 (74.0% and 93.4%) and qSOFA ≥ 2 (76.0% and 90.2%), respectively (Table 5; Figure 2). All three scores showed significant positive correlations, with the strongest correlation observed between NEWS2 and SOFA ($\rho = 0.68$), followed by NEWS2 and qSOFA ($\rho = 0.61$) and qSOFA and SOFA ($\rho = 0.59$; all $p < 0.001$) (Table 6; Figure 3).

Table 1. Baseline demographic and clinical characteristics according to in-hospital outcome

Parameter	Total (n=150)	Survivors (n=118)	Non-survivors (n=32)	p-value	Statistical test
Age (years), mean $\pm$ SD	58.6 $\pm$ 15.2	56.4 $\pm$ 14.8	66.7 $\pm$ 13.9	<0.001	Independent t-test
Male, n (%)	88 (58.7)	68 (57.6)	20 (62.5)	0.620	Chi-square test
Diabetes mellitus, n (%)	62 (41.3)	45 (38.1)	17 (53.1)	0.127	Chi-square test
Hypertension, n (%)	57 (38.0)	41 (34.7)	16 (50.0)	0.114	Chi-square test
Respiratory infection, n (%)	66 (44.0)	49 (41.5)	17 (53.1)	0.241	Chi-square test
Urinary infection, n (%)	38 (25.3)	32 (27.1)	6 (18.8)	0.338	Chi-square test
Abdominal infection, n (%)	27 (18.0)	22 (18.6)	5 (15.6)	0.692	Chi-square test
Other source, n (%)	19 (12.7)	15 (12.7)	4 (12.5)	0.974	Fisher's exact test

Table 2. Clinical and laboratory parameters according to in-hospital outcome

Parameter	Survivors (n=118)	Non-survivors (n=32)	p-value	Statistical test
Respiratory rate (/min)	23.4 $\pm$ 4.2	28.7 $\pm$ 5.1	<0.001	Independent t-test
Systolic BP (mmHg)	108.6 $\pm$ 18.4	91.8 $\pm$ 17.2	<0.001	Independent t-test
Heart rate (/min)	103.2 $\pm$ 17.5	116.4 $\pm$ 19.1	<0.001	Independent t-test
SpO ₂ (%)	93.8 $\pm$ 4.1	88.9 $\pm$ 6.2	<0.001	Independent t-test
GCS score, median (IQR)	14 (13–15)	11 (9–14)	<0.001	Mann–Whitney U test
Platelet count ($\times 10^3/\mu\text{L}$)	178 $\pm$ 82	124 $\pm$ 71	0.001	Independent t-test
Serum creatinine (mg/dL), median (IQR)	1.6 (1.1–2.3)	2.7 (1.8–4.1)	<0.001	Mann–Whitney U test
Serum bilirubin (mg/dL), median (IQR)	1.2 (0.8–1.9)	2.1 (1.2–3.4)	<0.001	Mann–Whitney U test

Table 3. Comparison of NEWS2, qSOFA and SOFA scores according to in-hospital outcome

Score	Total (n=150)	Survivors (n=118)	Non-survivors (n=32)	p-value	Statistical test
NEWS2	6.5 $\pm$ 2.6	5.8 $\pm$ 2.1	9.1 $\pm$ 2.3	<0.001	Independent t-test
qSOFA	1.3 $\pm$ 0.8	1.1 $\pm$ 0.7	2.0 $\pm$ 0.7	<0.001	Mann–Whitney U test
SOFA	6.3 $\pm$ 3.5	5.2 $\pm$ 2.6	10.3 $\pm$ 3.4	<0.001	Independent t-test

Table 4. ROC analysis for prediction of in-hospital mortality

Score	AUROC (95% CI)	Optimal cut-off	Sensitivity (%)	Specificity (%)	p-value
NEWS2	0.82 (0.75–0.89)	≥ 7	81.3	72.0	<0.001
qSOFA	0.74 (0.66–0.82)	≥ 2	68.8	78.0	<0.001
SOFA	0.88 (0.82–0.94)	≥ 8	84.4	81.4	<0.001

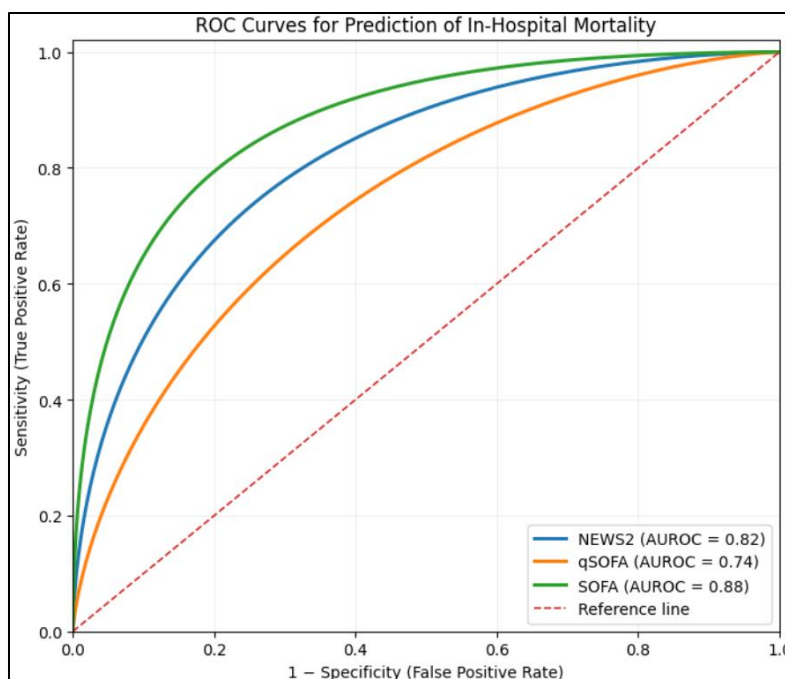


Figure 1. ROC analysis for prediction of in-hospital mortality

Table 5. Diagnostic performance at optimal cut-offs

Score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
NEWS2 ≥ 7	81.3	72.0	44.8	93.4	74.0
qSOFA ≥ 2	68.8	78.0	45.8	90.2	76.0
SOFA ≥ 8	84.4	81.4	55.1	95.0	82.0

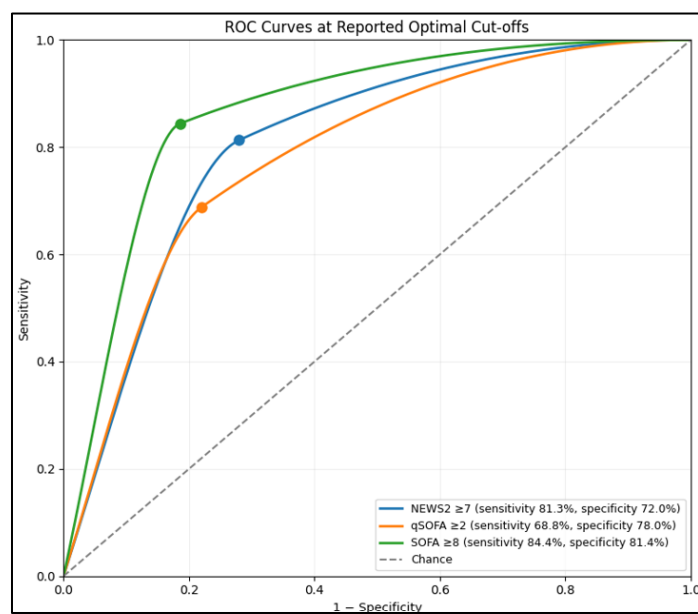


Figure 2. Diagnostic performance at optimal cut-offs

Table 6. Correlation between NEWS2, qSOFA and SOFA scores

Score comparison	Spearman's ρ	p-value	Statistical test
NEWS2 vs qSOFA	0.61	<0.001	Spearman rank correlation
NEWS2 vs SOFA	0.68	<0.001	
qSOFA vs SOFA	0.59	<0.001	

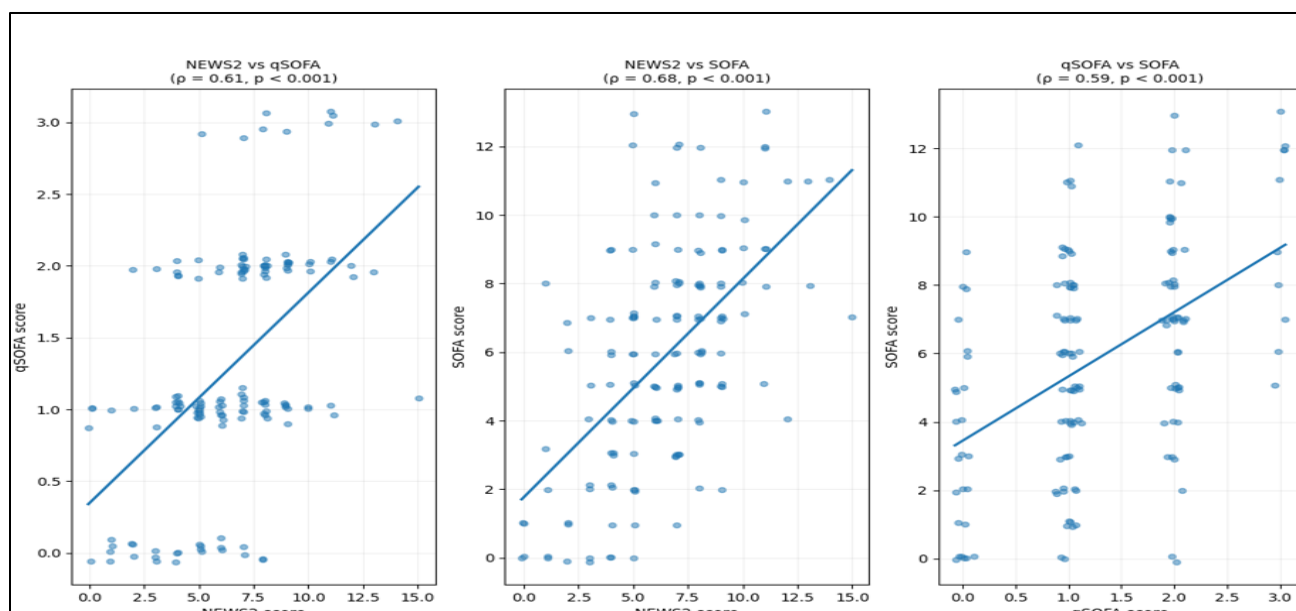


Figure 3. Correlation between NEWS2, qSOFA and SOFA scores

DISCUSSION

In the present study, in-hospital mortality was 21.3% (32/150). Non-survivors were significantly older than survivors (66.7 ± 13.9 vs. 56.4 ± 14.8 years; $p < 0.001$) and had greater physiological and laboratory derangements. Verma et al. [12] studied 373 Indian patients with sepsis and reported a mortality of 35.12%, indicating the substantial mortality burden associated with sepsis. NEWS2 and qSOFA scores were significantly higher among non-survivors than survivors (NEWS2: 9.1 ± 2.3 vs. 5.8 ± 2.1 ; qSOFA: 2.0 ± 0.7 vs. 1.1 ± 0.7 ; both $p < 0.001$). NEWS2 demonstrated better mortality discrimination than qSOFA, with AUROCs of 0.82 and 0.74, respectively. Similar findings were reported by Mellhammar et al. [13], who found NEWS2 superior to qSOFA, with AUCs of 0.80 vs. 0.70 in one cohort and 0.70 vs. 0.62 in another. Churpek et al. [14], in 30,677 infected patients, also reported better mortality discrimination with NEWS than qSOFA (AUC 0.77 vs. 0.69). Verma et al. [12] similarly demonstrated higher AUROC for NEWS2 than qSOFA (0.781 vs. 0.729; $p < 0.001$), with sensitivities of 83.21% and 77.10%, respectively. SOFA was markedly higher among non-survivors than survivors (10.3 ± 3.4 vs. 5.2 ± 2.6 ; $p < 0.001$). Among the three scores, SOFA showed the highest AUROC of 0.88, compared with 0.82 for NEWS2 and 0.74 for qSOFA. At a cut-off ≥ 8 , SOFA had 84.4% sensitivity, 81.4% specificity, and 82.0% accuracy. This indicates that comprehensive assessment of multiorgan dysfunction provides stronger mortality discrimination, although NEWS2 has the advantage of rapid bedside application without extensive laboratory investigations. At a cut-off ≥ 7 , NEWS2 demonstrated sensitivity of 81.3%, specificity of 72.0%, and NPV of 93.4%, whereas qSOFA ≥ 2 showed sensitivity of 68.8%,

specificity of 78.0%, and NPV of 90.2%. Verma et al. [12] similarly reported higher sensitivity and diagnostic efficiency for NEWS2 (83.21% and 66.48%) than qSOFA (77.10% and 54.95%). Horton et al. [15] further demonstrated the practical utility of early-warning score-based clinical decision support in sepsis, reporting a 23.36% reduction in normalized direct costs following implementation. Masson and Stephenson [16] also supported the predictive utility of NEWS2 for mortality among emergency-department patients. Significant positive correlations were observed between NEWS2 and qSOFA ($\rho = 0.61$), NEWS2 and SOFA ($\rho = 0.68$), and qSOFA and SOFA ($\rho = 0.59$), with all $p < 0.001$. The strongest correlation was between NEWS2 and SOFA, suggesting that physiological deterioration measured by NEWS2 parallels increasing organ dysfunction measured by SOFA. However, the scores assess different dimensions of severity and should not be considered interchangeable.

Strengths

1. The study directly compares three clinically relevant scoring systems—NEWS2, qSOFA and SOFA—for predicting in-hospital mortality among patients with sepsis.
2. The prospective observational design allows systematic assessment of clinical parameters and hospital outcomes.
3. All three scoring systems were evaluated in the same patient cohort, allowing direct comparison of their prognostic performance.
4. The study includes ROC curve analysis, AUROC values, sensitivity, specificity, predictive values and accuracy to assess diagnostic performance.

5. The inclusion of clinical and laboratory parameters provides a broader assessment of illness severity and organ dysfunction.
6. The findings highlight the potential complementary roles of rapid bedside assessment using NEWS2 and comprehensive organ dysfunction assessment using SOFA.

Future Directions

Future multicentre studies with larger sample sizes are needed to validate the prognostic performance of NEWS2, qSOFA and SOFA in diverse patient populations. Further research should evaluate serial changes in these scores during hospitalization and assess their association with clinical outcomes, including ICU admission, need for organ support and length of hospital stay. External validation of the proposed cut-off values and comparison of AUROCs using appropriate statistical methods may help establish their clinical applicability. Studies evaluating the integration of bedside scoring systems into early sepsis recognition and escalation protocols may further clarify their role in clinical practice.

Limitations

This was a single-center study with a relatively small sample size of 150 patients, which may limit generalizability. Additionally, the scores were assessed at admission, and serial changes during hospitalization were not evaluated.

CONCLUSION

SOFA demonstrated the highest predictive accuracy for in-hospital mortality, followed by NEWS2 and qSOFA. NEWS2 provided good discrimination with the advantage of rapid bedside assessment. Thus, NEWS2 may facilitate early risk stratification, while SOFA can provide more comprehensive prognostic assessment.

Declarations

Ethics Approval and Consent to Participate

Please provide the name of the Institutional Ethics Committee, approval/reference number and approval date. Also specify whether written informed consent was obtained from all participants or waived by the Ethics Committee.

Consent for Publication

Not applicable, as no identifiable individual patient information is reported. (*Please confirm.*)

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Conflict of Interest

The authors should disclose any competing interests or state that they have no conflicts of interest.

Author Contributions

Please specify the individual contributions of Dr. Aparna Pandey, Dr. Samuel Noklang and Dr. Ravi Kant Sharma to study conception, methodology, data collection, statistical analysis, manuscript drafting and critical revision, as applicable.

Data Availability Statement

Please specify whether the data supporting the findings of this study are available from the corresponding author upon reasonable request, publicly accessible in a repository, or subject to restrictions.

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Clinical Trial Registration

Not applicable, if this prospective observational study was not a clinical trial. (*Please confirm.*)

Use of Artificial Intelligence

The authors declare that no artificial intelligence (AI) tools were used in the preparation, writing, or editing of this manuscript.

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