RESEARCH PAPER

Carle's modified obstetric early warning score (Carle's OEWS) for prediction of obstetric morbidity, a prospective observational study

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ABSTRACT

Background: Critical maternal health complications leading to mortality remain major global concerns, especially in resource-limited settings. Early recognition of clinical deterioration is essential to improving maternal outcomes. Carle's maternal early warning score provides a simple physiological tool to identify women at increased risk.

Objective: To evaluate the predictive accuracy of Carle's OEWS in forecasting intensive care unit (ICU) admission, cases of maternal near-miss and death.

Methods: The study adopted a prospective observational approach at Aswan University Hospital from October 2024 to September 2025, including 3,000 pregnant or postpartum women. Carle's OEWS was calculated at admission and receiver operating characteristic (ROC) curves assessed predictive validity.

Results: A total of 150 women (5%) required ICU admission, of whom 87 (58%) were maternal near-miss cases and 12 (8%) died. Carle's OEWS demonstrated excellent predictive performance for ICU admission (AUC = 0.975), maternal near miss (AUC = 0.971), and maternal death (AUC = 0.996), with high true positive rate and specificity.

Conclusion: The Carle early warning scoring system is valuable for early identification of high-risk obstetric patients and can support timely clinical intervention to improve outcomes.

Keywords: Maternal morbidity; Maternal mortality; Early warning score; ICU admission; Near-miss; Carle's OEWS.

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INTRODUCTION

Maternal mortality continues to represent a major global public health concern. Although significant improvements in obstetric care have contributed to a decline in the maternal mortality ratio (MMR) [(1)], preventable deaths still occur, particularly in low-resource settings and among vulnerable populations [(2)]. Severe obstetric complications remain key drivers of maternal deaths worldwide [(3,4)]. The World Health Organization emphasizes that maternal health monitoring should extend beyond mortality statistics to include severe maternal morbidity, as early detection of high-risk women is crucial for improving clinical outcomes [(5)].

The leading causes of maternal mortality include postpartum hemorrhage, maternal infections, hypertensive disorders of pregnancy, complications related to unsafe abortion, cardiovascular conditions, amniotic fluid embolism, and pulmonary embolism [(6)]. Importantly, a large proportion of these deaths are considered preventable. Prompt recognition of clinical deterioration and immediate medical intervention can substantially lower mortality rates. Nevertheless, accurately identifying women who are at imminent risk of life-threatening complications remains a significant challenge in obstetric practice [(7,8)].

The Acute Physiology and Chronic Health Evaluation II (APACHE II) score is widely used to predict outcomes in critically ill non-pregnant patients [(9,10)]. However, the unique physiological adaptations of pregnancy may limit its predictive accuracy in obstetric intensive care settings. Consequently, several pregnancy-adapted early warning systems have been introduced to improve early recognition of maternal deterioration. Commonly used tools include the Modified Early Obstetric Warning Score (MEOWS), the Maternal Early Recognition Criteria (MERC), the Modified Early Warning System (MEWS), the Maternal Early Warning Trigger (MEWT), the Irish Maternity Early Warning System (IMEWS), and the ICNARC Obstetric Early Warning Score (OEWS) [(11-22)].

Comparative evaluations have been conducted in different settings. For example, an assessment in India examined the performance of the ICNARC OEWS against the APACHE II score [(22)], while a revised version of MEOWS was introduced in Rwanda but demonstrated relatively limited sensitivity and positive predictive value. A notable advantage of obstetric-specific scoring systems is their reliance on pregnancy-adjusted physiological parameters without the need for laboratory investigations. Although most of these tools have shown reasonable effectiveness in identifying women at risk of severe maternal morbidity, there is currently no globally standardized obstetric early warning system. Differences in included parameters and trigger thresholds contribute to variability in sensitivity and specificity across systems. Therefore, further refinement and

development of an optimized obstetric early warning score remain necessary [23].

This research was designed to evaluate the use of Carle's OEWS in predicting obstetric morbidity in women admitted to Aswan university hospital.

PATIENTS AND METHODS

Study design and setting

This study was designed as a prospective observational investigation conducted in the Department of Obstetrics and Gynecology, Aswan University Hospital, over a 12-month period (October 2024 to September 2025).

Study population

- **Inclusion criteria:** A total of 3,000 obstetric patients were enrolled, including pregnant women and women in the postpartum period (≤42 days) who were admitted to the obstetric ward, delivery suite, or operating theatre.
- **Exclusion criteria:** Women were excluded if they had incomplete medical records or declined participation.

Data collection

The following data were recorded for each participant:

- Demographic/obstetric variables: age, parity, gestational age, and mode of admission.
- Physiological monitoring variables: heart rate, arterial blood pressure, respiratory rate, temperature, oxygen saturation, level of consciousness (assessed using AVPU and/or GCS), and urine output.
- Scoring: Carle's Obstetric Early Warning Score (OEWS) was calculated at admission.
- Outcomes: obstetric ICU admission, maternal near-miss events, maternal death, and discharge outcome.
- The MOEWS variables and numeric cut-off values used for scoring are summarized in Table 1. Clinical assessment included temperature, respiratory rate, peripheral oxygen saturation, type of oxygen therapy (nasal cannula, face mask, non-invasive ventilation, or invasive mechanical ventilation), heart rate, blood pressure, and consciousness level (alert, responsive to voice, responsive to pain, or unresponsive). Laboratory tests were obtained from venous blood samples, while PaO_2 (mmHg) was measured using arterial blood gas (ABG) analysis.

Table (1): Cut-off limits of individual parameters of MOEWS score [7].

Parameter	3	2	1	0	1	2	3
Temperature (°C)	≤35		<36	36–37.4	37.5–38	38.1–38.9	≥39
Respiratory Rate (breaths/min)	<10		10–11	12–20		21–29	≥30
SpO_2 (%)	≤90	91–93	94–95	≥96			
Oxygen Therapy	Mask or higher	Nasal cannula		Room air			
Heart Rate (beats/min)	<50	50–59		60–99	100–109	110–129	≥130
Systolic BP (mmHg)	<90		90–99	100–139	140–149	150–159	≥160
Diastolic BP (mmHg)			≤45	46–89	90–99	100–109	≥110
Consciousness Level				Alert			Not alert

In this study, women with cardiovascular disease classified as Class III or IV according to the modified World Health Organization (mWHO) risk stratification were considered high-risk. Bedside echocardiography was performed in pregnant women with suspected cardiac disease during emergency assessments to evaluate cardiac structure and function. However, due to the physiological adaptations of pregnancy, early vital sign abnormalities associated with cardiac disease or postpartum hemorrhage may not be clearly evident. Therefore, an additional three points were incorporated into the MOEWS for women confirmed to have high-risk cardiac disease or severe postpartum hemorrhage.

The primary outcome of the study was severe maternal morbidity (definitions provided in Table 2). Demographic and clinical variables, including maternal age and gestational age, were recorded.

Outcome definition:

Severe maternal morbidity was defined as any of the following: obstetric ICU admission, massive transfusion, hysterectomy, use of vasopressors, mechanical ventilation, maternal near-miss, or death.

Recommended clinical reaction: The critical care alert system changes color according to the score assigned to each parameter in order to prompt timely clinical intervention. A score of 3 triggers a red alert, while a score of 2 generates a yellow alert. When the total MOEWS is ≤ 2, the current management plan is continued. If the MOEWS is 3–4, clinical observations are repeated more frequently. A MOEWS ≥ 5, or the presence of any single parameter scoring 3, warrants immediate admission to the intensive care unit (ICU).

For women diagnosed with severe postpartum hemorrhage or high-risk cardiovascular disease (mWHO Class III or IV) (Table 2), an additional three points were added to the total MOEWS score

Table (2): Clinical Definition Framework for Severe Maternal Morbidity

Critical maternal morbidity	**Diagnostic criteria**
Pregnancy-induced hypertension with proteinuria [19]	Diagnosis may be made when SBP ≥160 mmHg and/or DBP ≥110 mmHg with proteinuria ≥0.3 g/24 h (or ≥2+ by dipstick). Alternatively, SBP ≥140 mmHg and/or DBP ≥90 mmHg with clinically significant proteinuria can also be considered. Associated severity features include headache, visual symptoms, epigastric pain, clonus, platelets ≤100×10⁹/L, AST >50 IU/L, creatinine >100 µmol/L, or CrCl <80.8 mL/min. Cases of severe hypertension typically require IV antihypertensive therapy.
Eclampsia [24]	A severe manifestation of pre-eclampsia characterized by new-onset generalized tonic–clonic seizures.
Severe postpartum haemorrhage [25]	Defined by estimated blood loss ≥2000 mL, transfusion of ≥3 units of packed red cells, and/or hysterectomy, with or without uterine artery embolization.
Sepsis [19]	Suspected infection—whether culture-confirmed or not. that necessitates therapeutic (not prophylactic) antibiotics.
Shock [18]	Either persistent SBP <90 mmHg for ≥1 hour, or a drop in SBP ≥40 mmHg accompanied by tachycardia.
Pulmonary oedema [19]	Breathlessness with crepitations requiring treatment with diuretics.
Thromboembolism [12]	Includes pulmonary embolism confirmed by CTPA, or documented venous thrombosis involving pelvic, limb, or cerebral venous sinuses.
Diabetic ketoacidosis [19]	Significant hyperglycemia with acid–base derangement and ketonuria.
Intracranial tumour [19]	Diagnosis confirmed radiologically by CT or MRI.
Status epilepticus [19]	In women with known epilepsy, defined by prolonged and/or recurrent seizures.
Other serious medical conditions [19,26,27]	Includes major acute conditions such as pancreatitis, hepatic failure, acute fatty liver of pregnancy, acute appendicitis, or other severe systemic illnesses.

SBP Systolic Blood Pressure, **DBP** Diastolic blood pressure, **AST** Aspartate Aminotransferase, **Crvf** serum creatinine in venous fluid, **CrCl** creatinine clearance**,** **U** unit, **CTPA** Computed Tomography Pulmonary Angiography, **CT** computed tomography**,** **MRI** magnetic resonance imaging.

Sample size

The sample size was calculated based on the expected ability of the Obstetric Early Warning Score (OEWS) to discriminate women who require ICU admission. The minimum number of participants was derived using the conventional formula for estimating sample size when the primary performance measure is the area under the ROC curve (AUC):

$$N = \left(\frac{Z_{\alpha/2} \times \sqrt{1 - \mathrm{AUC}^2}}{\delta} \right)^2$$

Where:

- AUC represents the anticipated area under the ROC curve,
- $Z_{\alpha/2}$is the standard normal deviate for a two-sided α = 0.05 (Z = 1.96),
- δ denotes the required absolute precision (allowable error) around the AUC estimate.

For this study, the expected diagnostic performance was set at AUC = 0.60, with a target precision of δ = 0.025, and $Z_{\alpha/2} = 1.96$. Substituting these values:

$$N = \left(\frac{1.96 \times \sqrt{1 - (0.60)^2}}{0.025} \right)^2$$

Ethical approval

Ethical clearance for this study was obtained from the Institutional Review Board (IRB), Faculty of Medicine, Aswan University. Participant privacy was protected by using unique study codes and excluding any direct personal identifiers from the study database. All eligible women received a clear explanation of the study objectives, methodology, expected benefits, and potential risks, and written informed consent was secured before participation. The research was performed in accordance with the ethical standards of the World Medical Association's Declaration of Helsinki.

Statistical analysis

Data was organized and analyzed using SPSS version 26.0**.** Receiver operating characteristic (ROC) curves were constructed to evaluate the area under the curve (AUC**)** for each scoring system in predicting severe maternal morbidity. Key diagnostic performance metrics, including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)**,** were calculated. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The table demonstrates a comparison between women who required ICU admission (150 cases) and those who did not (2850 cases). A statistically significant association was observed with maternal age, as women above 30 years were more likely to require ICU admission, while most of the non-ICU group were aged 20–30 years (P=0.0001). Parity and previous CS showed no significant difference between the two groups (P=0.63) and (P=0.13) respectively. Regarding booking status, emergency admissions and referrals from other hospitals were strongly associated with increased ICU admission (P=0.0001).

Table (3): Demographic data and booking conditions in both groups

	ICU admission 150	No ICU admission 2850	P value
Age: ▪ <20 years ▪ 20-30 years ▪ >30 years	4 (2.7%) 82 (54.6%) 64 (42.7%)	110 (3.8 %) 2133 (74.8 %) 607 (21.4 %)	0.1 0.0001 0.0001
Parity: ▪ 1 ▪ 2 ▪ ≥3	65 (43.3 %) 43(28.7 %) 42 (28%)	1308 (45.9 %) 750 (26.3 %) 792 (27.2 %)	0.63 0.43 0.58
Previous CS	82 (54.7 %)	1128(39.6 %)	0.13
Booking: ▪ Referred from hospital outpatient clinic ▪ Emergency admission ▪ Referred from other hospitals	60 (40%) 30 (20 %) 60 (40%)	1777 (62.3 %) 466 (16.3 %) 607 (21.3 %)	0.0001 0.0001 0.0001

This table showed several comorbidities were significantly related to ICU admission, including hypertension (35.3% vs. 17.9%, P=0.00025), anemia (26.7% vs. 5.9%, P=0.0001), and placenta accreta (70% vs. 24.7%, P=0.0001). Similarly, cardiac, renal, and liver diseases showed a strong positive association with ICU admission. On the other hand, no significant differences were noted in cases of IUGR, PPROM, or oligohydramnios. Notably, the absence of morbidity was more common among non-ICU women (18.9%) compared to only 8.7% in the ICU group (P=0.0001). These findings highlight that the presence of comorbidities and high-risk obstetric conditions markedly increases the likelihood of requiring ICU care.

Table (4): Distribution of maternal morbidity

	ICU admission 150	No ICU admission 2850	P value
Hypertension	53 (35.3%)	510 (17.9%)	0.00025
Hypothyroidism	11 (7.3 %)	369 (12.9 %)	0.0046
Placenta accreta	105 (70 %)	705 (24.7 %)	0.0001
Anemia	40 (26.7%)	170 (5.9 %)	0.0001
Pregestational DM	8 (5.3%)	58 (2.04 %)	0.057
DKA	2 (1.3 %)	0	0.0036
PPROM	17 (11.3 %)	329 (11.5 %)	0.40
IUGR	15 (10 %)	247 (8.7%)	1.00
Preterm labour	49 (32.7 %)	439 (15.4 %)	0.0001
Oligohydramnios	10 (6.7 %)	153 (5.4 %)	0.87
Cardiac disease	5 (3.3 %)	2 (0.07 %)	0.0001
Renal disease	2 (1.3)	1 (0.04%)	0.010
Liver disease	3 (2 %)	2 (0.07 %)	0.0019
No morbidity	13 (8.7 %)	540 (18.9 %)	0.0001

This table (Table 5) showed that Hypertensive disorders of pregnancy represented the leading indication for ICU admission, accounting for 35.3% of all cases. Obstetric haemorrhage was the second most frequent cause (23.3%), followed by suspected sepsis (12.0%). Other medical and systemic conditions such as acute pulmonary edema, cardiovascular disease, and various medical comorbidities each contributed to a smaller proportion of admissions. These findings highlight that most ICU admissions were due to direct obstetric complications, emphasizing the continued burden of hypertensive and hemorrhagic disorders in maternal morbidity.

Table (5): common causes of ICU admission

Indication for ICU Admission	Frequency (150)	Proportion (%)
Pregnancy-associated hypertensive conditions	53	35.3
Cardiovascular conditions	5	3.3
Obstetric haemorrhage	35	23.3
Suspected sepsis	18	12.0
Acute pulmonary edema	6	4.0
Pulmonary embolus	3	2.0
Liver disease (liver failure, severe hepatitis, acute fatty liver of pregnancy, hepatitis B cirrhosis)	3	2.0

Systemic lupus erythematosus (SLE)	3	2.0
Acute pancreatitis	1	0.6
Acute appendicitis	1	0.6
Anaphylaxis	2	1.3
Malignancy	2	1.3
Diabetic ketoacidosis	2	1.3
Hyperthyroidism crisis	1	0.6
Neurological diseases	2	1.3
Respiratory diseases	2	1.3
Hematologic disorder	4	2.7
Deep vein thrombosis (DVT)	1	0.6
Other medical disorders	6	4.0

In table 6 the aggregate score was used to classify patients into distinct risk categories. A score of 0 indicated a normal category, while scores of up to 4.5 represented a low-risk group. Patients with scores of 4.5 or higher were considered at increased risk, indicating a higher likelihood of ICU admission. Scores of 5.5 or above suggested a risk of maternal near-miss, and those reaching 8.5 or higher were associated with a high risk of mortality.

Table (6): OEWS score risk categories

OEWS Score	Risk Category	Clinical Interpretation
0	Normal	No clinical concern
≤ 4.5	Low risk	Stable; routine monitoring sufficient
≥ 4.5	Higher risk	Increased likelihood of ICU admission
≥ 5.5	Near-miss risk	At risk of developing severe maternal morbidity
≥ 8.5	High mortality risk	Requires urgent and intensive intervention

Among the 3,000 women enrolled in the study, 150 (5%) required admission to the intensive care unit (ICU). Of these, 87 cases fulfilled the criteria for maternal near miss, while 12 women unfortunately succumbed to maternal mortality. Most participants, 2,988 women (99.6%), were successfully managed and discharged alive from the hospital (Table 7).

Table (7): Maternal Outcomes and ICU Admission Rates

Outcome	Number (n)	% of Total (n=3000)	ICU% admission (n=150)
Total women admitted	3,000	100%	
Required ICU admission	150	5.0%	100%
Near-miss cases	87		58.0%
Maternal deaths	12		8.0%
Discharged alive	2,988	99.6%	

In table (8); the ability of the OEWS to predict outcomes demonstrated excellent accuracy in identifying women at risk of severe outcomes For predicting ICU admission, the area under the receiver operating characteristic curve (AUROC) was 0.975. At a cut-off value of 4.5, the sensitivity was 96.0% and the specificity was 89.1%. The positive predictive value (PPV) was 36.3%, while the negative predictive value (NPV) was 99.7% (Figure 1).

Table (8): Predictive validity of Carle's Obstetric Early Warning Score in determining risk of ICU admission.

Positive Threshold (≥)	Sensitivity (%)	Specificity (%)
-1	100.0	0.0
0.5	98.68	33.56
1.5	98.68	46.42
2.5	98.68	59.11
3.5	98.68	80.15
4.5	**96.05**	**89.10**
5.5	88.16	96.08
6.5	78.95	99.15
7.5	65.79	99.49
8.5	42.11	99.83
9.5	23.68	99.91
10.5	11.84	100.0
11.5	9.21	100.0
12.5	3.95	100.0
14	0.0	100.0
Cut-off value = 4.5 Sensitivity**:** 96.1%**,** Specificity: 89.1%**,** PPV**:** 36.3%**,** NPV**:** 99.7%**,** Diagnostic Accuracy: 89.5%		

In table (9); in predicting maternal near-miss events, the area under the receiver operating characteristic curve (AUROC) was 0.971. At a cut-off value of 5.5, the sensitivity and specificity were 95.5% and 94.7%, respectively. The positive predictive value (PPV) was 40%, while the negative predictive value (NPV) reached 99.8% (Figure 1).

Table (9): Predictive Value of Carle's OEWS as a tool for maternal near-miss risk assessment

Positive Threshold (≥)	Sensitivity (%)	Specificity (%)
-1	100.0	0.0
0.5	97.7	32.9
1.5	97.7	45.5
2.5	97.7	57.9
3.5	97.7	78.5
4.5	97.7	87.5
5.5	**95.5**	**94.7**
6.5	86.4	98.0
7.5	75.0	98.7
8.5	50.0	99.7
9.5	22.7	99.8
11.0	6.8	100.0
12.5	4.5	100.0

14	0.0	100.0
Cut-off = 5.5 Sensitivity: 95.5%, Specificity: 94.7%, PPV: 40%, NPV: 99.8%, Diagnostic accuracy: 94.8%		

Table 10 shows that the area under the ROC curve for predicting maternal mortality was 0.996, indicating excellent discriminative performance. At a cut-off score of 8.5, Carle's OEWS achieved the analysis showed a sensitivity of 100% and a specificity of 97.9%. The positive predictive value (PPV) was 23.5%, whereas the negative predictive value (NPV) reached 100%, indicating that all maternal deaths were correctly identified (Figure 1).

Table (10): Assessment of Carle's OEWS for predicting maternal deaths

Positive Threshold (≥)	Sensitivity (%)	Specificity (%)
-1	100.0	0.0
0.5	100.0	31.8
1.5	100.0	43.96
2.5	100.0	55.96
3.5	100.0	75.85
4.5	100.0	84.46
5.5	100.0	91.55
6.5	100.0	95.01
7.5	100.0	96.14
8.5	**100.0**	**97.91**
9.5	87.5	99.03
10.5	75.0	99.76
11.5	50.0	99.76
12.5	12.5	99.84
14	0.0	100.0
Diagnostic cut-off = 8.5 Sensitivity: 100%, Specificity: 97.9%, PPV: 23.5%, NPV: 100%, Diagnostic Accuracy: 97.9%		

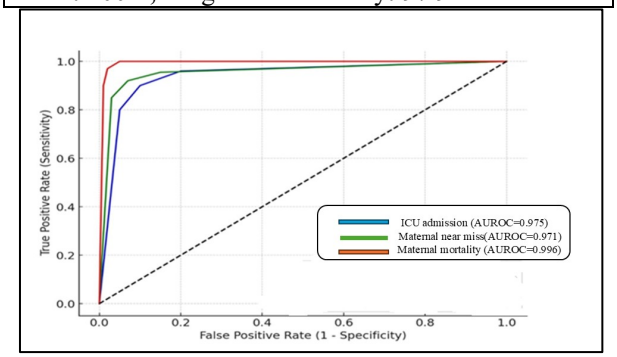


Figure (1): ROC curves of OEWS for prediction of maternal outcomes.

The analysis of relative risk for ICU admission across individual parameters revealed that the highest relative risk (RR = 41.12) was observed as one of the key predictors. This was followed by FiO_2 for SpO_2 ≥96%, which demonstrated a substantial risk with an RR of 20.25, and consciousness level, which showed an RR of 17.77. In contrast, diastolic blood pressure (DBP) did not show a statistically significant association with ICU admission (P = 0.12) (Figure 2).

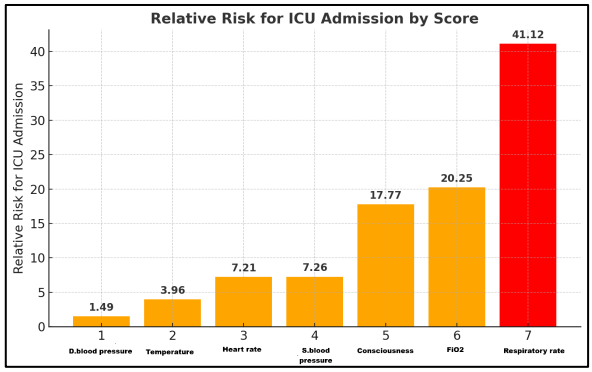


Figure (2): Relative risk of ICU admission per parameter (Carle's OEWS).

DISCUSSION

In our study, out of 3000 women, 150 (5%) required ICU admission. Maternal age was significantly associated with ICU admission, with women >30 years at higher risk (*P* = 0.0001), while parity and previous cesarean section showed no significant effect. Admission source was a strong predictor, as referrals from other hospitals and emergency admissions were more common among ICU cases (*P* = 0.0001), whereas women booked through hospital outpatient clinics were less likely to require ICU care (*P* = 0.0001). These findings are consistent with those reported by **Paternina-Caicedo et al.** [28], highlighting that any pregnancy can become high-risk during labor and underscoring the importance of implementing a universal safety system for all obstetric patients. Similar observations were made by **Singh et al.** [18,19], who found that unbooked women were at higher risk of experiencing maternal morbidity.

In the current study, respiratory rate and systolic blood pressure were the most frequently triggered parameters. This contrasts with previous validations of the Confidential Enquiry into Maternal and Child Health Modified Early Obstetric Warning Score (CEMACH MEOWS) [6,7,9]. The difference may be attributed to the higher trigger thresholds used in CEMACH MEOWS—21 breaths per minute for respiratory rate and 151 mmHg for systolic blood pressure—whereas Carle's Obstetric Early Warning Score employs lower thresholds of 18 breaths per minute and 140 mmHg, respectively. Diastolic blood pressure showed a similar frequency of triggering across all studies.

Ryan et al. [5], reported that the specificity of Confidential Enquiry-based Modified Early Obstetric Warning Score for predicting obstetric critical care unit admission improved from 54 percent to 72 percent when the criterion of at least one red trigger was applied, compared with the broader criterion of at least one red or two amber triggers. However, this specificity remained considerably lower than that of Obstetric Early Warning Score developed by Carle which demonstrated a specificity of 89.1 percent using a threshold value of 4.5 in the present study. Moreover, the high negative predictive value (99.7 percent) confirmed that no deteriorating patient was overlooked. In contrast, the relatively low positive

predictive value (36.3 percent) indicates that the tool is more suitable for use as a screening method rather than as a diagnostic instrument

Carle's obstetric early warning score demonstrated excellent predictive accuracy for maternal near-miss events at a threshold of 5.5, achieving a sensitivity of 95.5 percent and a specificity of 94.7 percent. This performance was notably superior to that reported in an Indian study employing the Confidential Enquiry into Maternal and Child Health Modified Early Obstetric Warning Score, which showed a sensitivity of 70 percent and a specificity of 84.4 percent [9]. Furthermore, Carle's score effectively predicted maternal mortality, with an area under the receiver operating characteristic curve of 0.996 (confidence interval: 0.092–1, P<0.001), consistent with findings from previous research [11,12]. Although earlier studies did not specify their cut-off thresholds and were conducted exclusively among intensive care unit patients, our analysis revealed that an aggregate score of 8.5 or higher achieved 100 percent sensitivity and 97.9 percent specificity in predicting maternal death. This highlights the tool's ability to ensure that no high-risk women remain unidentified.

Among the individual parameters, respiratory rate emerged as the strongest predictor of maternal deterioration. This finding is consistent with the observations of **Ryan et al. [5], and Singh et al. [19],** who likewise highlighted respiratory rate as a critical physiological marker, alongside temperature and level of consciousness, respectively. Our results further emphasize the vital importance of routinely assessing respiratory rate in all pregnant women, regardless of their baseline risk. From a physiological standpoint, pregnancy induces a state of respiratory alkalosis and reduces respiratory reserve; therefore, oxygen supplementation should be initiated when oxygen saturation falls to 96 percent or lower. The fraction of inspired oxygen required to maintain saturation above this threshold may serve as an early indicator of impending maternal decompensation.

Although altered consciousness was infrequently triggered (0.5%), it proved to be a highly significant predictor of adverse outcomes, with a relative risk of 17.7. This finding is in line with previous studies [7,12]. A non-alert state generally corresponds to a Glasgow Coma Scale score of 14 or lower, suggesting possible cerebral hypoxia and underscoring the urgent need for prompt intervention to prevent irreversible neurological injury.

Diastolic blood pressure was not significantly associated with adverse outcomes in our study (relative risk: 1.4), consistent with the findings of **Paternina-Caicedo et al. [28],** but in contrast to **Singh et al. [19]** who reported stronger associations between diastolic blood pressure and maternal morbidity. **Paternina-Caicedo et al. [28],** also emphasized this limitation of Carle's Obstetric Early Warning Score, noting that women with isolated diastolic blood pressure below 90 mmHg may be missed despite harboring potential risk. Our results therefore support reconsideration of the diastolic blood pressure thresholds in Carle's score to enhance its predictive performance.

Systolic blood pressure and heart rate showed results consistent with those reported in most studies, whereas temperature emerged as the least significant parameter overall. However, **Ryan et al. [5]** identified maximum temperature as having the highest β-coefficient, indicating possible variability across different study populations.

A key strength of this study is its prospective design, carried out among laboring women in a tertiary care setting with a sufficiently large sample size. Notably, it assessed Carle's Obstetric Early Warning Score, a scientifically refined improvement over the widely used CEMACH MEOWS. Admission to the obstetric critical care unit was chosen as a pragmatic endpoint, balancing clinical urgency with practical feasibility. Using morbidity alone could place an excessive burden on tertiary facilities, while relying solely on mortality would preclude timely intervention.

LIMITATION

This study was conducted at a single tertiary referral center, which may limit the generalizability of its findings to other healthcare settings with different patient populations or resource availability. Although the observational design was suitable for validation purposes, it did not permit evaluation of real-time clinical responses following OEWS-triggered**.**

CONCLUSION

Carle's Modified Obstetric Early Warning Score (Carle's OEWS) demonstrated excellent predictive accuracy for identifying women at risk of severe maternal morbidity and mortality. The score showed high sensitivity and specificity across all outcome measures, including ICU admission, maternal near-miss, and maternal death, confirming its value as an effective bedside screening tool. Integrating Carle's OEWS into routine obstetric surveillance can facilitate early recognition of clinical deterioration, timely intervention, and improved maternal outcomes. The score's simplicity, reliance on physiological parameters, and ease of use make it particularly suitable for implementation in both tertiary and under-resourced healthcare environments.

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