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Prospective Validation of the Obstetric Comorbidity Index for Predicting Severe Maternal Morbidity Among Referred Obstetric Patients at a Tertiary Care Centre in India

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ABSTRACT

Background: Severe maternal morbidity (SMM) is an important marker of obstetric care quality. The Obstetric Comorbidity Index (OBCMI) condenses pre-existing and pregnancy-related risk factors into a weighted admission score, but prospective evidence from Indian referral populations is limited.
Methods: This prospective cohort study enrolled 150 consecutively referred women at more than 28 weeks of gestation who were in labour or required emergency obstetric management at a tertiary centre in western Rajasthan. OBCMI was calculated at admission. Participants were followed through delivery and up to seven days postpartum or discharge. Discrimination for SMM was evaluated by receiver operating characteristic analysis; diagnostic indices were calculated at prespecified cut-offs.
Results: SMM occurred in 26 women (17.3%). Mean OBCMI was higher among women with SMM than among those without SMM (4.00±2.24 vs 1.28±1.58; $p<0.001$). SMM increased from 3.5% at score 0 to 44.0% at scores 4–5, 75.0% at scores 6–7, and 100% at score ≥8 ($p<0.001$). The area under the curve was 0.827 (95% CI 0.728–0.912). At the optimal cut-off ≥4, sensitivity was 69.2%, specificity 87.1%, positive predictive value 52.9%, negative predictive value 93.1%, and accuracy 84.0%. The odds of SMM were 15.19-fold higher at scores ≥4 than at lower scores.
Conclusion: Admission OBCMI showed good discrimination and a clear dose-response relationship with SMM in this high-acuity referral cohort. A score ≥4 can identify women needing prompt senior assessment and intensified surveillance, but its moderate sensitivity precludes using a lower score to exclude clinical deterioration.

Keywords: Obstetric Comorbidity Index; severe maternal morbidity; risk prediction; diagnostic accuracy; maternal triage.

INTRODUCTION

Severe maternal morbidity (SMM) comprises serious, unexpected complications of pregnancy, childbirth, or the postpartum period that produce important short- or long-term consequences for maternal health. Because maternal death is uncommon even in high-acuity facilities, SMM offers a more frequent and informative endpoint for surveillance and quality improvement.[1,2] Timely recognition is nevertheless difficult: serious deterioration may develop from several interacting medical and obstetric conditions before abnormal physiology becomes obvious.

The Obstetric Comorbidity Index (OBCMI) was developed to summarize maternal age and weighted comorbid conditions into a single score. In the original administrative-data cohort of 854,823 pregnancies, each one-point increase was associated with 37% higher odds of severe morbidity or death, although discrimination was moderate (c-statistic 0.657).[3] Subsequent external validations reported c-statistics near 0.67, while prospective clinical assessment produced better

discrimination and demonstrated a graded relationship between score and morbidity.[4-6] Expanded and locally adapted models have also been examined, but differences in outcome definitions, coding systems, and case mix limit direct transportability.[7-10]

Evidence from India remains sparse. A tertiary-centre study by Bolanthakodi et al. supported the association of increasing OBCMI with maternal morbidity,[11] but prospective validation in a predominantly referred population from western Rajasthan has not been reported. Referral cohorts are clinically important because delayed transfer, incomplete antenatal care, and a concentration of high-risk conditions may alter both baseline SMM prevalence and predictive values. Recent studies from Qatar and a United States level-IV referral centre similarly emphasize that performance should be interpreted in relation to the target population and intended triage use.[12,13]

This study therefore evaluated the diagnostic performance of the admission OBCMI (Obstetric Comorbidity Index) for predicting SMM (Severe maternal morbidity) among referred obstetric patients at a tertiary care centre. The secondary aims were to describe the score distribution, examine the dose-response relationship between score and SMM, and compare score profiles between women with and without SMM.

MATERIALS AND METHODS

Study design and setting: This prospective cohort study was conducted from February to May 2026 in the Department of Obstetrics and Gynaecology, Umaid Hospital, attached to Dr. Sampurnanand Medical College, Jodhpur, Rajasthan. The hospital is a tertiary referral centre receiving women from district, subdistrict, community, and private facilities across western Rajasthan.

Participants: Consecutively referred pregnant women at more than 28 weeks of gestation who were in labour or required delivery/emergency obstetric management were eligible when complete referral and antenatal records were available and written informed consent was provided. Women discharged before delivery, those lost before postpartum outcome assessment, and pregnancies with major fetal anomalies incompatible with life were excluded. The intended sample size was 150; the thesis calculation assumed 81% sensitivity, 16.8% SMM prevalence, 95% confidence, and the stated allowable precision.

Exposure assessment: At admission, the investigator obtained demographic and obstetric histories, referral information, clinical findings, and relevant records using a structured proforma. The OBCMI was calculated from the modified clinical scoring framework used in prospective validation studies, with weighted points assigned for maternal age and the presence of specified medical or obstetric conditions. The score was recorded before the study outcome was ascertained.

Outcome assessment: Women were followed through labour and delivery and during the immediate postpartum period, up to seven days after delivery or hospital discharge, whichever occurred first. SMM was determined by chart review using the study's prespecified ACOG/SMFM-derived clinical framework, which included severe haemorrhagic, hypertensive/neurological, renal, pulmonary, cardiac, septic, and major operative events. ICU admission, massive transfusion (at least four units of blood products), and emergency procedures such as hysterectomy or relaparotomy were among the recorded indicators. The term SMM is used throughout; cases were not relabelled as WHO maternal near-miss unless formal WHO organ-dysfunction criteria were documented.

Statistical analysis: Continuous data were summarized as mean±standard deviation or median with interquartile range; categorical data as number and percentage. OBCMI values were compared between outcome groups, and SMM frequency was examined across score bands. Receiver operating characteristic analysis estimated the area under the curve (AUC) with 95% confidence interval. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, and Youden index were evaluated at cut-offs from ≥3 to ≥6. For the selected threshold ≥4, the 2×2 table was independently reconstructed from the reported counts. Two-sided $p<0.05$ was considered significant. Analyses were performed in IBM SPSS Statistics version 26.0.

RESULTS

A total of 150 referred women were included; 26 met the study definition of SMM, giving an incidence of 17.3%. Mean age was 27.27±5.35 years. Most participants were rural (71.3%), and 104 (69.3%) were unbooked. Neither age, body mass index, residence, booking status, socioeconomic class, educational status, gravida, nor previous caesarean delivery showed a statistically significant association with SMM. Caesarean delivery occurred in 75 women (50.0%) and was more frequent among women with SMM than among those without SMM (73.1% [19/26] vs 45.2% [56/124]; p=0.017).

The OBCMI distribution was right-skewed: 85 women (56.7%) scored 0–1, 31 (20.7%) scored 2–3, and 34 (22.7%) scored ≥4. SMM increased across score bands, from 3.5% at score 0 to 44.0% at scores 4–5 and 75.0% at scores 6–7. The single participant with a score ≥8 experienced SMM. The overall association between score band and SMM was significant ($p<0.001$), although the estimate in the highest band was imprecise because it represented one patient.

Table 1. OBCMI score distribution and severe maternal morbidity

OBCMI score	n (%)	SMM, n	SMM rate, %	Non-SMM, n (%)
0	57 (38.0)	2	3.5	55 (96.5)
1	28 (18.7)	3	10.7	25 (89.3)
2–3	31 (20.7)	3	9.7	28 (90.3)
4–5	25 (16.7)	11	44.0	14 (56.0)
6–7	8 (5.3)	6	75.0	2 (25.0)
≥8	1 (0.7)	1	100.0	0 (0.0)
Total	150 (100)	26	17.3	124 (82.7)

Association across score bands: p<0.001. SMM, severe maternal morbidity; OBCMI, Obstetric Comorbidity Index.

Women with SMM had a mean OBCMI of 4.00±2.24 compared with 1.28±1.58 among women without SMM (t=7.37; p<0.001). Corresponding medians were 4 (IQR 2–6) and 1 (IQR 0–2). Under the three-category scheme, SMM occurred in 5 of 85 women (5.9%) at scores 0–1, 3 of 31 (9.7%) at scores 2–3, and 18 of 34 (52.9%) at scores ≥4 (p<0.001).

Table 2. OBCMI score according to SMM status

Statistic	SMM (n=26)	Non-SMM (n=124)
Mean±SD	4.00±2.24	1.28±1.58
Median (IQR)	4 (2–6)	1 (0–2)
Range	0–9	0–6
Between-group test	t=7.37; p<0.001	—

IQR, interquartile range; SD, standard deviation.

The OBCMI showed good discrimination, with an AUC of 0.827 (95% CI 0.728–0.912; p<0.001). A cut-off ≥4 maximized the reported Youden index (0.563), yielding 69.2% sensitivity, 87.1% specificity, 52.9% PPV, 93.1% NPV, and 84.0% accuracy. Reconstruction of the threshold table produced 18 true positives, 16 false positives, 8 false negatives, and 108 true negatives. Thus, 30.8% of SMM cases were not identified by this threshold. The odds ratio for SMM at score ≥4 versus <4 was 15.19 (95% CI 5.67–40.65; p<0.001).

Table 3. Diagnostic performance of OBCMI at selected cut-offs

Measure	≥3	≥4 (optimal)	≥5	≥6
Sensitivity, %	69.2	69.2	50.0	26.9
Specificity, %	84.7	87.1	92.7	98.4
PPV, %	48.6	52.9	59.1	77.8
NPV, %	92.9	93.1	89.8	86.5
Accuracy, %	82.0	84.0	85.3	86.0
Youden index	0.539	0.563	0.427	0.253

AUC for the continuous score: 0.827 (95% CI 0.728–0.912; p<0.001). NPV, negative predictive value; PPV, positive predictive value.

Table 4. Reconstructed 2×2 table for OBCMI cut-off ≥4

OBCMI result	SMM	No SMM	Total
Score ≥4	18	16	34
Score <4	8	108	116
Total	26	124	150

Values were reconstructed from the thesis score-band counts and independently used to verify sensitivity, specificity, PPV, NPV, accuracy, and the odds ratio.

DISCUSSION

This prospective study found that admission OBCMI had good discrimination for SMM in a referred, high-acuity obstetric cohort. Three findings are particularly relevant. First, the mean score among women with SMM was more than three times that among women without SMM. Second, the probability of SMM increased sharply at scores ≥4, demonstrating a clinically coherent dose-response pattern. Third, the ≥4 threshold provided high specificity and NPV but only moderate sensitivity, making it more appropriate as a high-risk flag than as a stand-alone rule-out test.

The observed AUC of 0.827 exceeds the c-statistic of 0.657 reported in the original Bateman derivation study and the approximately 0.67 observed in the Canadian external validation.[3,4] This difference is plausible rather than necessarily indicating a superior model. The original studies used large administrative datasets and broadly representative delivery populations, whereas the present study used prospective clinical assessment in a selected referral cohort. Easter et al. likewise reported improved clinical performance when the score was calculated in real time and outcomes were adjudicated

clinically.[6] Differences in prevalence, spectrum of illness, predictor ascertainment, and outcome definitions can materially change apparent model performance.

Our score gradient is consistent with contemporary validations. In the Qatar cohort, mean OBCMI was higher among women with SMM, the AUC was 0.66, and a threshold of 4 had specificity above 90%.12 McCarter et al. demonstrated an association between increased OBCMI and SMM among antepartum transfers to a level-IV centre, a population conceptually similar to the referred women in the current study.[13] Indian data from Bolanthakodi et al. also support use of the score to identify women at increased risk.[11] Taken together, these studies indicate that OBCMI is robust as a measure of increasing burden, although absolute risks and operating characteristics vary by setting.

At ≥4, the present study identified 18 of 26 SMM cases but missed eight. The NPV of 93.1% appears reassuring, yet it is influenced by the proportion without SMM and must not be interpreted as proof that low-scoring women can safely receive reduced observation. Acute haemorrhage, sepsis, anaesthetic complications, or intrapartum deterioration may occur despite a modest admission comorbidity burden. The index should therefore complement, not replace, physiological warning scores, serial bedside assessment, and clinician judgement. Reassessment may be especially valuable after major clinical events or at shift changes, as used in prospective work by Easter et al.[6]

The PPV of 52.9% means that approximately half of women scoring ≥4 developed SMM in this referral cohort. This is potentially useful for prioritizing senior review, anaesthesia input, blood-bank readiness, and closer monitoring. Nevertheless, the threshold was selected and evaluated in the same small dataset; apparent performance is therefore optimistic until externally validated. The three- or four-level care pathways proposed in the thesis should be considered exploratory rather than locally validated clinical protocols. In particular, mandatory HDU or ICU admission cannot be justified solely from this study, and the ≥8 estimate is based on one participant.

The 17.3% SMM frequency is far higher than rates in unselected administrative cohorts. This reflects the deliberate inclusion of referred women requiring delivery or emergency obstetric management, many of whom were unbooked. It also affects PPV and NPV, which are prevalence-dependent. Consequently, the results should not be generalized to routine antenatal clinics, lower-risk delivery units, or all obstetric admissions. The study instead provides evidence relevant to triage within a tertiary referral service.

Interpretation of SMM also requires caution. ICU admission was included among the study indicators and occurred in nearly all classified SMM cases. ICU thresholds vary across hospitals and can be influenced by bed availability and local practice. The study outcome should not be equated automatically with WHO maternal near-miss, which requires specific organ-dysfunction criteria.2 We therefore retained the SMM terminology and avoided the unsupported near-miss reclassification.

Strengths include prospective consecutive enrolment, calculation of OBCMI at admission, complete in-hospital follow-up, and an explicit diagnostic-accuracy analysis. Limitations include the single-centre referral design, only 26 outcome events, absence of blinded independent outcome adjudication, and follow-up ending at seven days or discharge. Future multicentre validation should prespecify the score version and SMM definition, use blinded adjudication, report calibration as well as discrimination, and evaluate whether OBCMI-guided escalation improves patient outcomes or resource use.

CONCLUSION

The OBCMI demonstrated good discrimination for SMM among referred obstetric patients at a tertiary centre in western Rajasthan. A score ≥4 identified a subgroup with markedly increased risk and high specificity, supporting its use as an admission red flag for prompt senior assessment and enhanced surveillance. Because sensitivity was 69.2%, a score below 4 cannot exclude subsequent SMM. External validation and prospective impact studies are required before score-based mandatory HDU or ICU pathways are adopted.

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CONFLICT OF INTEREST: The authors declare no conflict of interest.

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ETHICAL APPROVAL

The study was undertaken after approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment.

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