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Original Research Article

A study to assess the role of modified biophysical profile in prediction of perinatal outcome in high-risk pregnancy

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ABSTRACT

Background: High-risk pregnancies are associated with increased maternal and fetal morbidity and mortality, particularly in resource-limited settings. Effective antenatal surveillance is critical for improving outcomes, and the Modified Biophysical Profile (MBPP) has emerged as a practical tool due to its simplicity and reliability. This study aimed to assess the diagnostic value of MBPP in predicting adverse perinatal outcomes in high-risk pregnancies and to use it a primary surveillance tool.

Methods: A prospective observational study was conducted at SMS Medical College, Jaipur, from July 2023, involving 200 high-risk pregnant women (≥32 weeks gestation). MBPP, comprising non-stress test (NST) and amniotic fluid index (AFI), was used to monitor fetal well-being. Outcomes such as mode of delivery, APGAR scores, NICU admissions, and neonatal complications were evaluated. Statistical analysis was performed to determine the predictive performance of MBPP, NST, and AFI.

Results: Out of the 200 cases, 63% underwent caesarean delivery. Abnormal MBPP was observed in 54% of cases and was significantly associated with fetal distress, NICU admissions, and low APGAR scores. MBPP showed high sensitivity and accuracy in predicting adverse outcomes, outperforming AFI and being comparable to NST. Anemia (26%), previous caesarean (20%), and oligohydramnios (18.5%) were the most common risk factors. Respiratory distress (45.5%) was the leading cause of NICU admission.

Conclusions: MBPP is a reliable, non-invasive, and cost-effective screening method for high-risk pregnancies, aiding in early detection of fetal compromise and timely intervention to improve perinatal outcomes.

Keywords: High-risk pregnancy, Modified biophysical profile, MBPP, Non-stress test, Amniotic fluid index, Fetal distress, NICU admission, Fetal surveillance, Perinatal outcome

INTRODUCTION

High-risk pregnancies complicated by conditions such as preeclampsia, eclampsia, anemia and oligohydramnios are major contributors to perinatal morbidity and mortality. Early recognition of these pregnancies is crucial, as timely interventions can significantly reduce perinatal loss.[1] Antenatal fetal assessment plays a vital role in detecting fetuses at risk of intrauterine hypoxia, a condition that may lead to permanent damage or fetal death. Consequently, clinicians have long searched for fetal surveillance methods that are non-invasive, accurate, simple, reproducible and capable of providing rapid results.

The classical biophysical profile (BPP) is an established method of fetal evaluation; however, it requires assessment of multiple parameters, fetal breathing movements, fetal tone, gross body movements, amniotic fluid volume and a non-stress test, making it more time-

consuming, complex and expensive. To overcome these limitations, Nageotte et al introduced the modified biophysical profile (MBPP), which combines only two indicators: the non-stress test (NST), a sensitive marker of acute fetal status, and the amniotic fluid index (AFI), which reflects long-term placental function.[2] This streamlined approach is easier to perform, less time-intensive and has been shown to be as effective as the complete BPP in evaluating fetal wellbeing.[3,4]

Maternal health and perinatal outcomes are of great public health significance, particularly in India where the average perinatal mortality rate remains around 16 per 1000 live births.[5] Since many maternal high-risk conditions predispose to adverse neonatal outcomes, reliable monitoring methods such as the MBPP are essential.

MBPP is non-invasive, cost-effective, and helps in optimizing outcomes by supporting expectant management and reducing unnecessary operative interventions. This study aimed to assess the diagnostic value of MBPP in high-risk pregnancies and to use it a primary antepartum surveillance tool due to its simplicity and effectiveness.

METHODS

Study overview

A prospective observational study was conducted at the Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur, from July 2023 to December 2024. It included pregnant women (≥32 weeks gestation) with high-risk factors. Ethics approval was obtained.

Inclusion criteria

Pregnant women were eligible if they were ≥32 weeks gestation with one or more high-risk factors like hypertension, IUGR, GDM, anemia, decreased fetal movements, BOH, systemic diseases, oligohydramnios, or stillbirth history.

Exclusion criteria

Women were excluded if they had known fetal congenital anomalies, were in active labour, or presented with multifetal gestation, active bleeding, ruptured membranes, or intrauterine fetal demise.

Methodology

High-risk antenatal women ≥32 weeks were enrolled after screening. Consent was obtained, and demographic, clinical, and obstetric data were recorded. Baseline tests were done. Each underwent modified biophysical profile (NST and AFI assessment). MBPP was repeated based on risk. Management decisions were individualized. Perinatal outcomes like NICU admission, birth weight, and neonatal complications were analyzed statistically.

Statistical analysis

We had used Microsoft Office for the collection of data. We used chi-square test, student's t-test for the comparison of groups. The p value of <0.05 was considered statistically significant.

RESULTS

The present observational study was conducted on 200 high-risk pregnant women at or beyond 32 weeks of gestation attending the ANC, OPD and Labour Room of the Department of Obstetrics and Gynaecology, SMS Medical College and Attached Hospitals, Jaipur. Most participants were between 25-29 years of age (51%), followed by 19-24 years (39%), with a mean age of 25.51±3.59 years. The majority were Hindu (78%), while 22% were Muslim. Socioeconomic assessment showed that 44.5% belonged to the lower-middle class, 25.5% to the middle class, 24% to the lower class, and only 3% each to the upper-middle and upper classes. Multigravida women constituted 63.5% of the study population, whereas 36.5% were primigravida. The mean gestational age was 37.53±1.91 weeks, indicating that most deliveries occurred close to term.

Figure 1: Demographic profile.

Parameters	Category	N (%)
Mean age (in years)		25.51±3.59
Religion	Hindu	78
	Muslim	22
Socioeconomic Status	Lower class	24
	Lower-middle class	44.50
	Middle class	25.50
	Upper-middle class	3
	Upper class	3
Gravida status	Primigravida	36.50
	Multigravida	63.50
Gestational age	Mean GA	37.53±0.91 weeks

Among 200 high-risk pregnancies, 63% underwent caesarean section, predominantly full-term (60%). Vaginal deliveries accounted for 37%, with 34% being full-term. Most newborns (81.5%) had an APGAR score ≥7, while 33% required NICU admission. Fetal distress occurred in 40%, and 38% had meconium-stained liquor. MBPP findings showed 46% had favorable parameters (adequate AFI with reactive NST), while 54% showed concerning signs like inadequate AFI or non-reactive NST, indicating a high caesarean rate and significant fetal risk factors.

Figure 2: Delivery mode, fetal outcome, and modified biophysical profile overview.

Mode of delivery		N	%
Adequate AFI/ reactive non-stress test	No	92	46
Adequate AFI/non-reactive non-stress test	No	56	28
Inadequate AFI/ reactive non-stress test	No	43	21.5
Inadequate AFI/nonreactive non-stress test	No	9	4.5
Full term	Vaginal delivery	68	34
	Caesarean section	120	60
Pre term	Vaginal delivery	6	3
	Caesarean section	6	3
APGAR score at 5min	<7	37	18.5
	≥7	163	81.5
Fetal distress	Yes	80	40
	No	120	60
MSL	Yes	76	38
	No	124	62
NICU admission	Yes	66	33
	No	134	67

The analysis of high-risk factors in this study showed that anaemia was the most common risk factor (26%) followed by previous caesarean sections in 40 (20%) and oligohydramnios in 37 (18.5%) cases. Hypertensive disorder (16%), decreased fetal movements (14.5%), post-datism (11.5%), IUGR (10%), gestational diabetes (8%), previous stillbirth (5%), Rh-negative status (3%) and IHCP (2.5%) were other risk factors. The observed disparity in the high-risk factors can be attributed to the coexistence of multiple risk factors in individual women, highlighting the complex interplay of maternal and fetal complication in high-risk pregnancies.

AFI showed moderate specificity but low sensitivity across outcomes, with highest accuracy for <7 APGAR (70%). NST demonstrated high sensitivity, specificity, and accuracy for all outcomes, particularly fetal distress and MSL (100% sensitivity, >92% accuracy). MBPP had perfect sensitivity for <7 APGAR, high sensitivity for other outcomes, but lower specificity, yielding moderate-to-high accuracy.

The most common indication for NICU admission among the newborns was respiratory distress (45.5%). This was followed by low birth weight (LBW) in 11 (17%) neonate, neonatal jaundice and hypoglycemic attack, each in 6 (9%) neonates. Additionally, LBW with prematurity was observed in 5 (7.5%) neonates, and LBW with distress was seen in another 6 (9%) newborns. These findings highlight that respiratory distress and complications related to low birth weight were the primary reasons for NICU admissions in the study population.

Figure 3: Distribution of cases according to high risk factors.

High risk factors	N	%
Anemia	52	26
IUGR	20	10
Decreased fetal movement	29	14.5
GDM	16	8
HDP	32	16
IHCP	5	2.5
Oligohydramnios	37	18.5
Post-datism	23	11.5
Previous CS	40	20
Previous still birth	10	5
Rh negative	6	3

Figure 4: Diagnostic performance of AFI for various parameters.

Parameters	Diagnostic parameters				
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
AFI					
<7 APGAR score at 5 min	40.1	76.8	33.1	84.46	70
Fetal distress	38	78.4	50.1	60.2	60
MSL	56.3	72.1	40.6	63.4	58
NICU admission	33.73	70	34.2	65.54	61
Parameters	NST				
<7 APGAR score at 5 min	77.84	84.85	83.5	96.3	79
Fetal distress	100	81.25	88.89	100	92.5
MSL	100	85.53	91.85	100	94.5
NICU admission	89.55	77.27	88.89	78.46	85.5
Parameter	MBPP				
<7 APGAR score at 5 min	100	58.08	32.04	100	65
Fetal distress	93.75	76.67	72.82	94.85	83.5

Continued.

Parameters	Diagnostic parameters				
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
MSL	93.42	74.19	68.93	94.85	81.5
NICU admission	75.8	60.6	55.15	40.78	70.1

Figure 5: Distribution Of cases according to indications of NICU admission.

Indication of NICU admission	N	Percentage
Respiratory distress	30	45.5
LBW	11	17
Neonatal jaundice	6	9
LBW with prematurity	5	7.5
Hypoglycemic attack	8	12
LBW with distress	6	9
Total	66	100

DISCUSSION

In this study, most women were 25-29 years old (51%), followed by 19-24 years (39%), with only 10% in the 30-34-year group. The mean age was 25.51±3.59 years. Similar trends were noted by Arya et al, Anupama et al and Ain et al who also found the highest proportion of participants in the younger age groups.[6-8]

In the present study, most neonates (41.5%) had a birth weight of 2.5-3 kg, followed by 36% weighing 1.5-2.4 kg, while only 17% weighed more than 3 kg and 5.5% were below 1.5 kg. The mean birth weight was 2.5±0.52 kg, indicating that although many newborns had normal birth weight, a considerable proportion remained low birth weight. Jahan et al reported similar findings, with most neonates weighing between 2.1-2.5 kg (33%) and 2.6-3 kg (28%), and a mean birth weight of 2.62±0.53 kg, consistent with the observations of Fernandes et al (2023).[9,10]

The diagnostic performance of AFI in predicting adverse outcomes was limited, with sensitivities of 40.1% for low APGAR (<7 at 5 min), 38% for fetal distress, 56.3% for MSL, and 33.7% for NICU admission, with accuracies of 58–70%. Similarly, Anjum et al reported sensitivity of 50% and specificity of 79.6% for low APGAR, and lower sensitivities for fetal distress (15.3%) and NICU admission (23.4%).[11]

NST showed better predictive accuracy, with 77.8% sensitivity and 84.9% specificity for low APGAR, 100% sensitivity for fetal distress and MSL, and 89.5% sensitivity for NICU admission. Anjum et al also reported high sensitivities but lower specificities, while Gonzalez et al found 33% sensitivity and 89% specificity.[11,12]

In this study, 63% women underwent caesarean section and 37% delivered vaginally, with full-term caesarean (60%) most common. Other studies like Shalini et al, Maurya et al observed higher vaginal delivery rates (59-60%) and fewer LSCS cases.[13,14]

Most neonates (81.5%) had APGAR ≥7, while 18.5% scored <7. MSL occurred in 38% and 33% required NICU admission. Sonia et al similarly found 76% good perinatal outcomes, with NICU admissions mainly due to respiratory distress or MSAF.[15]

Among high-risk pregnancies, 46% had favorable MBPP (normal AFI and NST), while 4.5% had both abnormal, comparable to Shalini et al.[8] Anaemia (26%) was the most common high-risk factor, followed by previous LSCS (20%) and oligohydramnios (18.5%). Other risks included hypertension (16%), decreased fetal movements (14.5%), post-datism (11.5%), IUGR (10%), and GDM (8%). Similar trends were noted by Shalini et al and Maurya et al.[13,14]

Limitations

This study had several limitations that should be considered while interpreting the results. As it was conducted in a single tertiary care center, the findings may not be fully generalizable to the broader population, particularly because the study population reflects a referral-based demographic. The relatively small sample size also limits the statistical power to detect all potential associations or variations in perinatal outcomes, indicating the need for larger studies to strengthen external validity. Additionally, the observational design introduces the possibility of confounding factors and biases that could not be completely controlled, preventing the establishment of definitive causal relationships.

CONCLUSION

The study found that MBPP had sensitivity of 75.8% and specificity of 60.6% for predicting NICU admissions, highlighting its effectiveness in identifying fetuses at risk. A normal MBPP indicates fetal well-being and favourable outcomes, while an abnormal result may signal fetal distress, prompting further evaluation or timely intervention. MBPP thus helps obstetricians to make decisions on delivery timing, reducing the risk of

iatrogenic prematurity and improving perinatal outcomes. In high-risk cases, it can guide referrals to advanced care centers with NICU facilities. Given its accessibility, cost-effectiveness, and reliability, MBPP proves to be a valuable tool in managing high-risk pregnancies and enhancing both maternal and neonatal safety through early detection and intervention.

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