Association Between Biophysical Profile (BPP) Score With Perinatal Outcome

Sathi Khanom*[1], Mursheda Akhter[2], Kamrun Nahar[3], Sajid Bin Ashraf Sami[4], Mitu Debnath[5], Begum Hosne Ara[6]

[1]Deputy Director Cum Consultant (Gynae), Nazira Bazar Maternity Centre, Dhaka South City Corporation, Dhaka, Bangladesh
[2]Junior Consultant, Department Of Obstetrics & Gynecology, District Sadar Hospital, Narshingdi, Bangladesh
[3]Consultant, Department Of Obstetrics & Gynecology, Lalkuthy Mother And Child Specialized Hospital, Dhaka, Bangladesh
[4]Medical Officer, Sir Salimullah Medical College Hospital, Dhaka, Bangladesh
[5]Consultant, Department Of Obstetrics & Gynecology, Tangail Sadar Hospital, Tangail, Bangladesh
[6]Professor & Head Of Department, Department Of Obstetrics & Gynecology, Dhaka Central International Medical College & Hospital, Dhaka, Bangladesh
*Correspondence: Dr. Sathi Khanom

Abstract

Background: *Adverse perinatal outcomes, such as low Apgar scores, birth asphyxia, and neonatal morbidity, are significant public health concerns, particularly in developing countries like Bangladesh. The Biophysical Profile (BPP) is a prenatal diagnostic tool used to assess fetal well-being and predict perinatal outcomes. This study aimed to investigate the association between BPP scores and perinatal outcomes in a Bangladeshi population.*

Methods: *This cross-sectional analytical study included 150 pregnant women at or above 36 weeks of gestation, recruited from the Department of Obstetrics and Gynaecology, Institute of Child and Mother Health, Dhaka. BPP scoring was conducted using ultrasound and fetal heart rate monitoring. The study assessed the correlation between BPP scores and various perinatal outcomes, including Apgar scores, birth asphyxia, and neonatal morbidity. Data were analyzed using statistical methods, with a focus on the association between BPP scores and perinatal outcomes.*

Result: *The study revealed that neonates with a BPP score of 6 had a 100% incidence of Apgar scores <7 at 1 minute, in stark contrast to 2.65% in those with a BPP score of 10 (P-value: 0.001s). Furthermore, a BPP score of 10 was associated with 97.35% healthy babies. The study also highlighted the influence of maternal age and socio-economic status on perinatal outcomes.*

Conclusion: *The study underscores the importance of BPP as a predictive tool for perinatal outcomes in a Bangladeshi setting. The significant association between BPP scores and neonatal outcomes highlights the need for incorporating BPP into routine antenatal care, especially in developing countries. This approach could lead to early identification of high-risk pregnancies and timely interventions, potentially improving neonatal health outcomes.*

Keywords: *Pregnancy, Perinatal, Biophysical Profile Score, Perinatal Outcome*

I.   INTRODUCTION

Globally, adverse perinatal outcomes, which include complications such as preterm birth, low birth weight, and neonatal morbidity, represent a significant challenge in public health. The World Health Organization reports that approximately 15 million babies are born preterm each year, accounting for over 10% of all births worldwide, with preterm birth rates varying across regions (1). In Asia, the burden of these outcomes is particularly pronounced. A study conducted across several South Asian and Latin American settings, including Bangladesh, highlighted the complexities of managing perinatal risks in low- and middle-income countries. This study found significant variations in maternal and newborn outcomes based on the mode of birth, especially among women with a history of prior cesarean birth (2). In Bangladesh, the situation is even more critical. There is a high

prevalence of adverse perinatal outcomes, reflective of broader trends in developing nations. A study in rural Bangladesh evaluating the Institute of Medicine recommendations on gestational weight gain found associations with various adverse perinatal outcomes, including preterm birth and low birth weight (3). These findings are indicative of the multifaceted nature of perinatal health challenges in the region. Against this backdrop, the Biophysical Profile (BPP) has emerged as an essential tool in obstetric care. This prenatal ultrasound evaluation, which combines fetal heart rate monitoring with observations of fetal movements, tone, breathing, and amniotic fluid volume, is particularly valuable in predicting adverse perinatal outcomes. Its relevance is underscored by the global and regional statistics that highlight the pressing need for effective prenatal assessment and intervention strategies to improve perinatal outcomes. The frequency of adverse perinatal outcomes in patients with poor BPP scores is alarmingly high. A study by Rehman et al. revealed that among patients with poor BPP, 72.2% underwent cesarean sections, and 90.1% had poor Apgar scores at 5 minutes (4). This finding is consistent with other research, such as the study by Usmani et al., which also reported a high incidence of cesarean sections (72.2%) and poor Apgar scores (90.1%) in this demographic (5). Similarly, Jamil et al. found that 75% of patients with poor BPP scores required cesarean sections, and 92% had poor Apgar scores (6). These studies collectively underscore the critical role of BPP in predicting and managing perinatal risks. The association between BPP scores and perinatal outcomes is further complicated by various maternal and fetal factors. For instance, maternal anemia, a prevalent condition in Bangladesh, has been linked to increased risks of adverse maternal health and birth outcomes, including preterm birth and perinatal mortality (7). This highlights the multifaceted nature of perinatal risks and the need for comprehensive prenatal assessments like the BPP. Moreover, the prevalence of conditions such as oligohydramnios, which is associated with adverse outcomes like preterm delivery and low birth weight, is found to be around 8.5% (8). This prevalence underscores the importance of early detection and intervention, where BPP can play a pivotal role. The BPP's ability to assess amniotic fluid volume makes it an invaluable tool in managing such high-risk pregnancies. Despite the established utility of BPP in clinical settings, there remains a need for more extensive research, particularly in diverse populations and settings. The current literature, while informative, often lacks consistency in findings and sometimes fails to address specific demographic factors, such as those prevalent in Bangladesh. This gap in research presents an opportunity for further investigation into the nuances of how BPP scores correlate with perinatal outcomes in different populations. This study aims to contribute to this body of knowledge by exploring the association between BPP scores and perinatal outcomes, with a particular focus on the Bangladeshi population.

II.   METHODS

This cross-sectional analytical study was conducted in the Department of Obstetrics and Gynaecology at the Institute of Child and Mother Health, Dhaka, from November 2017 to October 2018. The original sample size calculated was 384, but due to the limited duration of the study (12 months), the sample was restricted to 150 pregnant women selected through a purposive convenient sampling method. The study population comprised pregnant women at or above 36 weeks of gestation. Inclusion criteria included pregnant women at or above 36 weeks gestation who underwent Biophysical Profile (BPP) scoring. Exclusion criteria were impending eclampsia/pre-eclampsia, gestational diabetes mellitus, fetal distress, antepartum hemorrhage, and gross congenital anomalies in the fetus. The BPP, a prenatal ultrasound evaluation of fetal well-being, involves a scoring system (Manning's score). It is typically conducted when an NST is non-reactive or for other obstetrical indications (9). The components of the BPP and their respective scores include NST (2), fetal breathing movements (2), gross body movements (2), fetal muscle tone (2), and amniotic fluid index (2), totaling a score of 10. A BPP score ≤6 is significantly associated with early neonatal morbidity, and this study aimed to evaluate the correlation between the BPP and perinatal outcomes. BPP scoring was conducted using ultrasound (USG) in a single lab by a single operator. The BPP included parameters such as Non-Stress Test (NST) performed by Cardiotocography (CTG), and measurements of amniotic fluid volume, fetal breathing movement, gross body movement, and fetal tone by USG. Post-delivery, data on the mode of delivery (spontaneous vaginal delivery/LUCS), early perinatal outcome, and neonatal outcome were evaluated. Outcome variables measured included baseline parameters of the study population (age, occupation, socio-economic status), BPP score by USG, mode of delivery, Apgar score, and perinatal outcomes (healthy baby, birth asphyxia, neonatal death, stillborn, NICU admission, neonatal death). Data were collected using a preformed data collection sheet (questionnaire) after obtaining informed consent from the subjects. This included detailed history and physical examination. Maternal and fetal outcomes were recorded in the data collection sheet. Data analysis was performed using SPSS version 20, presented in tables and graphs, and associations were tested using the Chi-square statistical test. Ethical considerations included obtaining permission from the Ethical Review Committee of ICMH. The study's purpose, risks, and benefits were explained to the subjects, and only those who gave consent were included. Written informed consent was obtained, and the privacy of the subjects was strictly maintained. The right of patients to refuse or withdraw from the study was respected.

III. RESULTS

Table 1: Distribution of the study patients by demographic variable (n=150)

Demographic Variable	Number of patients	Percentage
Age (Years)		
18-25	93	62.00%
26-30	34	22.67%
>30	23	15.33%
Mean±SD	25.23±5.12	
Range(min-max)	18-35	
Occupation		
Housewife	131	87.33%
Service	15	10.00%
Other	4	2.67%
Socio-economic status		
Low-income	79	52.67%
Lower-middle income	67	44.67%
Upper-middle income	4	2.67%

In this study of 150 patients, the age distribution revealed a predominance of younger women, with 62.00% (n=93) aged between 18 and 25 years, followed by 22.67% (n=34) in the 26-30 year age group, and 15.33% (n=23) over 30 years. The mean age of the participants was 25.23 years, with a standard deviation of 5.12, encompassing a range from 18 to 35 years. The majority of the study participants were housewives, accounting for 87.33% (n=131) of the sample, while 10.00% (n=15) were in service, and a small fraction, 2.67% (n=4), belonged to other occupational categories. In terms of socio-economic status, over half of the participants, 52.67% (n=79), were from low-income backgrounds, 44.67% (n=67) were from lower-middle-income groups, and a minimal 2.67% (n=4) were from upper-middle-income brackets.
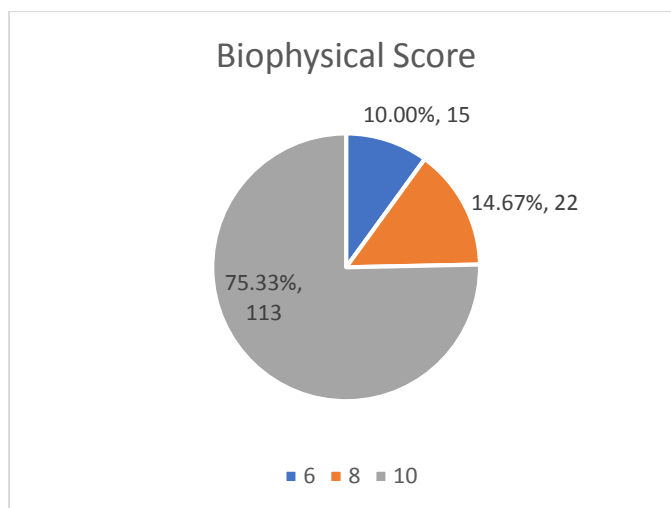
Figure 1: Distribution of the study patients by biophysical score (n=150)

In the assessment of biophysical scores among the 150 study patients, a significant majority, 75.33% (n=113), exhibited a biophysical score of 10, indicating generally favorable prenatal assessments. A smaller proportion of the participants had lower scores, with 14.67% (n=22) scoring 8 and 10.00% (n=15) scoring 6. The mean biophysical score across the study cohort was 9.31, with a standard deviation of 1.31, reflecting a range of scores from 6 to 10.

Table 2: Association between biophysical score and Apgar score (1min)

Apgar score (1min)	Score 6		Score 8		Score 10		P value
	n	%	n	%	n	%	
<7	15	100.00%	7	31.82%	3	2.65%	0.001s
≥7	0	0.00%	15	68.18%	110	97.35%	
Total	15	100.00%	22	100.00%	113	100.00%	

Table 2 illustrates a significant association between biophysical scores and Apgar scores at 1 minute, as evidenced by a P value of 0.001. All patients (100%, n=15) with a biophysical score of 6 had an Apgar score of less than 7, indicating a clear correlation between lower biophysical scores and lower Apgar scores. In contrast, for patients with a biophysical score of 8, 31.82% (n=7) had an Apgar score of less than 7, while the majority, 68.18% (n=15), had an Apgar score of 7 or higher. Among those with a biophysical score of 10, only a small fraction, 2.65% (n=3), had an Apgar score of less than 7, with the overwhelming majority, 97.35% (n=110), scoring 7 or above.

Table 3: Association between biophysical score and Apgar score (5min)

Apgar score (5min)	Score 6		Score 8		Score 10		P value
	n	%	n	%	n	%	
<7	8	53.33%	0	0.00%	0	0.00%	0.001s
≥7	7	46.67%	22	100.00%	113	100.00%	
Total	15	100.00%	22	100.00%	113	100.00%	

Table 3 presents the association between biophysical scores and Apgar scores at 5 minutes, with a statistically significant P value of 0.001. Among patients with a biophysical score of 6, 53.33% (n=8) had an Apgar score of less than 7 at 5 minutes, while 46.67% (n=7) scored 7 or higher. Notably, for patients with biophysical scores of 8 and 10, none (0%) had an Apgar score of less than 7 at 5 minutes, indicating a strong positive correlation between higher biophysical scores and better Apgar scores at this time point. All patients with scores of 8 (n=22) and 10 (n=113) achieved Apgar scores of 7 or above.

Table 4: Association of BBP score with perinatal outcome

Perinatal outcome	Score 6		Score 8		Score 10		P value
	n	%	n	%	n	%	
Healthy baby	4	26.67%	15	68.18%	110	97.35%	0.001s
Birth asphyxia	8	53.33%	7	31.82%	3	2.65%	
Neonatal death	3	20.00%	0	0.00%	0	0.00%	
Still born	0	0.00%	0	0.00%	0	0.00%	
Total	15	100.00%	22	100.00%	113	100.00%	

Table 4 demonstrates a statistically significant association (P value = 0.001) between biophysical profile scores and perinatal outcomes. Among patients with a BPP score of 6, only 26.67% (n=4) resulted in a healthy baby, while a substantial 53.33% (n=8) experienced birth asphyxia, and 20.00% (n=3) led to neonatal death. In contrast, for patients with a BPP score of 8, a higher percentage, 68.18% (n=15), had a healthy baby, and 31.82% (n=7) experienced birth asphyxia, with no cases of neonatal death or stillbirth. Remarkably, in the group with a BPP score of 10, a vast majority, 97.35% (n=110), had healthy babies, and only a minimal 2.65% (n=3) experienced birth asphyxia, with no instances of neonatal death or stillbirth.

IV.   DISCUSSION

The current study included 150 pregnant women, predominantly within the younger age brackets, with 62.00% falling between 18-25 years and 22.67% between 26-30 years. This age distribution is noteworthy, as maternal age can be a significant factor in perinatal outcomes (10). The mean age of the participants was approximately 25 years, indicating a relatively young cohort, which is reflective of the general reproductive trends in the region. Occupationally, a vast majority of the participants were housewives (87.33%), a detail that aligns with the socio-cultural norms of the study area. This occupational distribution is important to consider, as it may influence aspects such as access to healthcare and health education, which are critical factors in maternal and perinatal health. Socio-economically, the study population was primarily composed of individuals from low

(52.67%) and lower-middle (44.67%) income backgrounds, with a small representation from the upper-middle income bracket (2.67%). This socio-economic makeup is significant, as it is well-documented in literature that socio-economic status can have a profound impact on health outcomes. In the context of perinatal health, lower socio-economic status often correlates with increased risks of adverse outcomes, potentially due to factors like reduced access to quality healthcare, nutritional challenges, and higher levels of stress (11,12). Our study's primary finding, highlighting the significant association between lower BPP scores and adverse neonatal outcomes, particularly lower Apgar scores at both 1 and 5 minutes, aligns with the trends observed in obstetric research worldwide. Specifically, we found that 100% of neonates with a BPP score of 6 had an Apgar score of less than 7 at 1 minute, a stark contrast to only 2.65% in the BPP score 10 group (P-value: 0.001s). This correlation is crucial as it underscores the predictive value of BPP in assessing immediate neonatal outcomes. The study by Vemala Asgari Begum et al. (2023) in high-risk pregnancies corroborates this observation, demonstrating a similar association between BPP scores and neonatal Apgar scores (13). This parallel finding across different research contexts reinforces the role of BPP as a critical tool in antenatal surveillance, guiding clinical decisions and interventions in obstetric care. Moreover, the strong correlation we observed between higher BPP scores and favorable perinatal outcomes, particularly the high percentage of healthy babies in the BPP score 10 group (97.35%), echoes the findings of Medhat Helmy et al. (2021) (14). Their study, focusing on severe intrauterine growth restriction cases, found significant associations between BPP and various perinatal outcomes. This similarity in findings highlights the utility of BPP in managing high-risk pregnancies, offering a tool for early intervention and potentially improving neonatal outcomes. In a broader comparative analysis, the efficacy of the original versus modified BPP in high-risk pregnancies, as explored by Jamal et al., provides a contextual backdrop for our findings (15). While our study did not differentiate between types of BPP, the overarching trend of higher scores predicting better outcomes aligns with their research. This suggests a universal applicability of BPP in obstetric care, regardless of the specific methodology employed, and underscores its importance in predicting perinatal outcomes. Additionally, the association of low BPP scores with increased neonatal admissions and deaths, as observed in our study, finds support in the work of Gurmeet Singh et al. (2017). Their study in India found a significant correlation between BPP scores and neonatal outcomes, further validating the BPP as a vital tool in antenatal surveillance (16). This consistency across different geographical contexts and study designs not only reinforces the findings of our study but also highlights the BPP's role in global obstetric practice.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. CONCLUSION

The findings of our study, conducted with 150 pregnant women primarily from younger age groups and lower socio-economic backgrounds in Bangladesh, underscore the critical role of the Biophysical Profile (BPP) in predicting perinatal outcomes. Our research reveals a clear association between lower BPP scores and adverse neonatal outcomes, particularly in terms of Apgar scores at 1 and 5 minutes. This association is particularly pronounced in neonates with a BPP score of 6, where 100% exhibited an Apgar score of less than 7 at 1 minute, compared to a mere 2.65% in the BPP score 10 group. These findings are in line with global obstetric research, highlighting the BPP's utility as a predictive tool in antenatal care. The strong correlation between higher BPP scores and favorable perinatal outcomes, especially the high percentage of healthy babies in the BPP score 10 group, further validates the importance of BPP in managing high-risk pregnancies. This correlation suggests that BPP can serve as an effective tool for early intervention, potentially improving neonatal outcomes. Our study's alignment with similar research conducted in different geographical contexts and under varying conditions reinforces the universal applicability of BPP in obstetric care. It highlights its significance not only as a diagnostic tool but also as a guide for clinical decision-making and interventions in obstetric care.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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