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Pregnancy Outcomes Associated with Moderate Elevations in Blood Pressure or Blood Glucose in Bangladeshi Women

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ABSTRACT

Background: Moderate elevations in blood pressure (BP) or blood glucose below conventional diagnostic thresholds may still be associated with adverse pregnancy outcomes. However, evidence from Bangladesh remains limited. **Objective:** To assess pregnancy outcomes associated with moderate elevations in BP and/or blood glucose among pregnant women attending a district hospital in Bangladesh. **Methods & Materials:** This cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, 100 Bedded District Hospital, Narsingdi, Bangladesh, from July 202[5] to June 2026. A total of 50 pregnant women were enrolled purposively and categorized into Group I (no moderate BP or glucose elevation, n=25) and Group II (moderate BP and/or glucose elevation, n=25). Demographic, obstetric, BP, and glucose data were collected, and maternal and neonatal outcomes were assessed. Statistical analysis was performed using SPSS version 22.0, with $p<0.05$ considered statistically significant. Results: Group II had significantly higher mean BMI (26.0±3.1 vs. 24.1±2.8 kg/m²), systolic BP (128.4±6.5 vs. 112.8±7.1 mmHg), diastolic BP (81.2±4.8 vs. 71.6±5.2 mmHg), and glucose levels (112.8±12.4 vs. 91.6±8.7 mg/dL). Gestational hypertension, preeclampsia, GDM, cesarean delivery, and preterm birth were more frequent in Group II. Neonatal hypoglycemia and NICU admission were also more common in Group II, while polyhydramnios was also evaluated as an antenatal outcome. Combined BP and glucose elevation was associated with higher adjusted odds of adverse pregnancy outcomes (aOR 4.91, 95% CI 1.01–23.78; p=0.049). **Conclusion:** Moderate BP and/or glucose elevations may identify pregnant women at increased risk of adverse maternal and neonatal outcomes. Larger prospective multicenter studies are warranted.

Keywords: *Pregnancy outcomes; Blood pressure; Blood glucose; Gestational hypertension; Gestational diabetes mellitus.*

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INTRODUCTION

Pregnancy is accompanied by substantial cardiovascular and metabolic adaptations, and abnormalities in blood pressure (BP) and glucose metabolism are important determinants of maternal, fetal, and neonatal health. Hypertensive disorders of pregnancy and hyperglycemia are traditionally defined using established diagnostic thresholds. However, increasing evidence suggests that the relationship between maternal BP or glucose concentration and adverse pregnancy outcomes may be continuous rather than restricted to women who meet conventional diagnostic criteria. This distinction is particularly relevant in low- and middle-income countries, where cardiometabolic risk during pregnancy is substantial and early identification of women at increased risk may improve antenatal surveillance and outcomes.[1,2]

Hypertension is an important cause of maternal and perinatal morbidity. Although a BP of ≥140/90 mmHg remains the conventional threshold for hypertension in pregnancy, evidence indicates that adverse outcomes may occur across lower BP categories. A systematic review of 23 studies found a stepwise relationship between American College of Cardiology/American Heart Association (ACC/AHA) BP categories measured before 20 weeks of gestation and pre-eclampsia. Compared with BP <120/80 mmHg, higher categories were associated with progressively greater risk, although BP <140/90 mmHg was not sufficiently useful to rule out adverse outcomes and the authors did not recommend replacing the conventional diagnostic threshold.[3] A separate systematic review and meta-analysis involving 23 cohort studies also found that high BP before or during early pregnancy was associated with hypertensive disorders, pre-eclampsia, preterm birth, stillbirth, and neonatal intensive care admission.[4]

Evidence from South Asia is particularly relevant to Bangladesh. A population-based cohort study involving Bangladesh, Pakistan, and Tanzania included BP data from 9,448 women, including 2,894 women from Bangladesh. Using ACC/AHA criteria, 12.4% had elevated BP and 15.2% had stage 1 hypertension. The ACC/AHA approach identified additional women with hypertension compared with the traditional JNC7 criteria, and ACC/AHA-defined hypertension was associated with stillbirth; however, both approaches demonstrated limited sensitivity and positive predictive value for predicting stillbirth and preterm birth.[5] Recent evidence from South Africa similarly found that stage 1 hypertension before 20 weeks was associated with progression to stage 2 hypertension and postpartum hypertension, although several fetal outcomes did not differ significantly between groups.[6] Furthermore, a 2025 cohort of 2,069 twin pregnancies reported that stage 1 hypertension before 20 weeks was associated with higher risks of hypertensive disorders, gestational hypertension, pre-eclampsia, early preterm birth, and small-for-gestational-age birth.[7] These findings support investigation of intermediate BP elevations while recognizing that risk estimates may differ according to population and pregnancy characteristics.

Glucose metabolism during pregnancy also appears to have a continuous relationship with adverse outcomes. The landmark Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study evaluated 25,505 pregnant women from 15 centres in nine countries and demonstrated continuous associations between maternal fasting, 1-

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hour, and 2-hour glucose concentrations and adverse outcomes, including birth weight above the 90th percentile, primary cesarean delivery, neonatal hypoglycemia, and fetal hyperinsulinemia. Importantly, no clear glucose threshold was identified at which risk abruptly increased.[8] Subsequent systematic-review evidence has confirmed associations between gestational diabetes and several adverse maternal and neonatal outcomes, including cesarean delivery, preterm birth, macrosomia, and large-for-gestational-age birth.[9] More recent analyses using contemporary diagnostic criteria have also demonstrated associations of GDM with pre-eclampsia, pregnancy-induced hypertension, and cesarean delivery.[10]

The concept of moderate cardiometabolic abnormalities is directly relevant to the proposed research. In a prospective cohort study of 2,857 Ugandan women, Milln et al. specifically evaluated moderate elevations in BP or blood glucose, defining moderate BP elevation as ACC/AHA stage 1 hypertension and moderate hyperglycemia as fasting glucose in the GDM range. Stage 1 hypertension was associated with more than a two-fold increase in the odds of perinatal death, whereas GDM-range fasting hyperglycemia was associated with cesarean delivery.[8] This study provides a particularly relevant framework for investigating whether similar associations exist among Bangladeshi women. Current clinical evidence also emphasizes that mild or moderate abnormalities should be considered in the broader context of maternal cardiovascular and metabolic risk rather than only as dichotomous disease categories.[11,12]

Bangladesh has a substantial burden of gestational diabetes. A systematic review and meta-analysis specifically examining Bangladeshi women documented considerable variation in GDM prevalence according to diagnostic criteria and population characteristics.[13] Nationally representative Bangladesh Demographic and Health Survey data have also demonstrated an important burden of GDM and identified maternal characteristics associated with the condition.[14] A recent Bangladeshi cohort further reported significantly higher rates of hypertensive disorders, cesarean delivery, preterm birth, macrosomia, neonatal hypoglycemia, and NICU admission among women with GDM compared with women without GDM.[15]

Despite this evidence, data specifically evaluating moderate elevations in BP or blood glucose below or around conventional diagnostic thresholds and their subsequent pregnancy outcomes among Bangladeshi women remain limited. Most Bangladeshi research has focused on women already diagnosed with hypertension or GDM rather than examining intermediate levels of cardiometabolic abnormality. Therefore, the present study aims to assess pregnancy outcomes associated with moderate elevations in BP or blood glucose among Bangladeshi women, with particular attention to hypertensive disorders, pre-eclampsia, cesarean delivery, preterm birth, abnormal birth weight, neonatal hypoglycemia, NICU admission, and perinatal outcomes.

OBJECTIVES

1. To assess pregnancy outcomes associated with moderate blood pressure elevation.
2. To assess pregnancy outcomes associated with moderate blood glucose elevation.

METHODS & MATERIALS

The cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, 100 Bedded District Hospital, Narsingdi, Bangladesh. The study was carried out over six months from July 2025 to June 2026. A total of 50 pregnant women attending the Department of Obstetrics and Gynaecology during the study period were enrolled purposively according to the predefined inclusion and exclusion criteria.

Inclusion Criteria

- Pregnant women aged ≥18 years.
- Women with a singleton pregnancy.
- Women attending antenatal care during the study period.
- Women with available blood pressure and blood glucose measurements.
- Women who provided informed written consent to participate in the study.

Exclusion Criteria

- Women with known chronic hypertension diagnosed before pregnancy.
- Women with pre-existing diabetes mellitus diagnosed before pregnancy.
- Women with multiple pregnancies.
- Women with known major fetal congenital anomalies.
- Women with severe pre-existing cardiac, renal, or hepatic disease.
- Women who did not provide informed consent.

A total of 50 eligible pregnant women were enrolled purposively during the study period. Participants were assessed for blood pressure and blood glucose levels during antenatal care. Blood pressure was measured using a standard validated sphygmomanometer after an appropriate period of rest, with the participant in a comfortable sitting position. Blood glucose was assessed using the standard laboratory protocol of the hospital.

For the purpose of this study, moderate elevation in blood pressure was defined as a blood pressure level above the normal range but below the conventional diagnostic threshold for hypertension, according to the predefined study criteria. Similarly, moderate elevation in blood glucose was defined as a blood glucose level above the normal range but below the conventional diagnostic threshold for diabetes mellitus/gestational diabetes mellitus. The exact predefined cutoff values were applied consistently to all participants.

Based on these measurements, participants were categorized into two groups: Group I—women without moderate elevation in blood pressure or blood glucose, and Group II—women with moderate elevation in blood pressure and/or blood glucose. Pregnancy outcomes were subsequently compared between the two groups to determine whether moderate elevations in blood pressure or blood glucose were associated with adverse pregnancy outcomes.

Data were collected using a structured preformed data collection sheet. Baseline demographic and obstetric variables, including age, residence, gestational age, parity, body mass index, previous obstetric history, and relevant medical history, were recorded. Clinical variables, including systolic blood pressure, diastolic blood pressure, and blood glucose level, were documented.

Maternal outcomes included gestational hypertension, preeclampsia, gestational diabetes mellitus, mode of delivery, and preterm delivery. A composite maternal outcome was defined as the occurrence of at least one prespecified maternal complication, including gestational hypertension, preeclampsia, or gestational diabetes mellitus. Each participant was counted only once in the composite outcome, irrespective of the number of these complications experienced.

Fetal and neonatal outcomes included birth weight, low birth weight, macrosomia, small-for-gestational-age or large-for-gestational-age birth, neonatal hypoglycemia, neonatal intensive care unit admission, stillbirth, and other relevant adverse perinatal outcomes. Polyhydramnios was also assessed as an antenatal fetal outcome and recorded separately from neonatal outcomes based on the available antenatal clinical and ultrasonography records. The occurrence of these outcomes was compared between women with and without moderate elevations in blood pressure and/or blood glucose.

Ethical approval was obtained from the appropriate Ethical Review Committee of the 100 Bedded District Hospital, Narsingdi, before commencement of the study. Informed written consent was obtained from all participants before enrollment. Confidentiality of participant information was strictly maintained, and the collected data were used solely for research purposes.

Statistical Analysis

All data were recorded systematically in a preformed data collection form. Quantitative data were expressed as mean ± standard deviation, while qualitative data were expressed as frequency and percentage. Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS), version 22. Continuous variables were compared using the appropriate parametric or non-parametric tests, while categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. The association between moderate elevations in blood pressure and/or blood glucose and pregnancy outcomes was assessed by calculating appropriate measures of association. A p-value of less than 0.05 was considered statistically significant. Confidentiality of all participant information was strictly maintained throughout the study.

RESULT

Table I shows the demographic and obstetric characteristics of the study participants. The mean age was 26.2 ± 4.1 years in Group I and 27.8 ± 4.6 years in Group II. Most participants were aged 25–29 years. Rural residence was more common in both groups. The mean gestational age was comparable between the groups, while BMI was significantly higher in Group II (26.0 ± 3.1 vs. 24.1 ± 2.8 kg/m², p=0.028). Parity distribution was similar between the groups.

Table I

Demographic and obstetric characteristics of the study participants.

Characteristics	Group I: No moderate elevation (n=25)	Group II: Moderate BP and/or glucose elevation (n=25)	p-value
Age group, n (%)			
18–24 years	8 (32.0)	5 (20.0)	0.419
25–29 years	11 (44.0)	10 (40.0)	
≥30 years	6 (24.0)	10 (40.0)	
Age (years), mean ± SD	26.2 ± 4.1	27.8 ± 4.6	0.2
Residence			
Urban	11 (44.0)	9 (36.0)	0.564
Rural	14 (56.0)	16 (64.0)	
Gestational age at enrollment (weeks), mean ± SD	23.8 ± 4.5	24.6 ± 4.2	0.519
BMI (kg/m²), mean ± SD	24.1 ± 2.8	26.0 ± 3.1	0.028
Parity			
Primigravida	14 (56.0)	12 (48.0)	0.571
Multigravida	11 (44.0)	13 (52.0)	

Table II shows the blood pressure and blood glucose status of the participants. Mean systolic and diastolic blood pressure and blood glucose levels were significantly higher in Group II than in Group I (all p<0.001). Moderate blood pressure elevation was present in 52.0% of Group II, while moderate glucose elevation was present in 32.0%; 16.0% had combined moderate BP and glucose elevation.

Table II

Distribution of participants according to blood pressure and blood glucose status.

Clinical/biochemical parameter	Group I: No moderate elevation (n=25)	Group II: Moderate BP and/or glucose elevation (n=25)	p-value
Systolic BP (mmHg), mean ± SD	112.8 ± 7.1	128.4 ± 6.5	<0.001
Diastolic BP (mmHg), mean ± SD	71.6 ± 5.2	81.2 ± 4.8	<0.001
Blood glucose (mg/dL), mean ± SD	91.6 ± 8.7	112.8 ± 12.4	<0.001
Moderate BP elevation	0 (0.0)	13 (52.0)	<0.001
Moderate glucose elevation	0 (0.0)	8 (32.0)	0.004
Moderate BP + glucose elevation,	0 (0.0)	4 (16.0)	0.11

Table III shows the maternal pregnancy outcomes according to study group. Gestational hypertension, preeclampsia, gestational diabetes mellitus, cesarean delivery, and preterm delivery were more frequent in Group II than in Group I. Any maternal complication occurred in 44.0% of women in Group II compared with 16.0% in Group I, with an OR of 4.12 (95% CI: 1.09–15.59).

Table III

Maternal pregnancy outcomes according to study group.

Maternal outcome	Group I n (%)	Group II n (%)	OR (95% CI)	p-value
Gestational hypertension	1 (4.0)	5 (20.0)	6.00 (0.65–55.66)	0.19
Preeclampsia	1 (4.0)	4 (16.0)	4.57 (0.47–44.17)	0.349
Gestational diabetes mellitus	1 (4.0)	5 (20.0)	6.00 (0.65–55.66)	0.19
Cesarean delivery	9 (36.0)	15 (60.0)	2.67 (0.85–8.37)	0.156
Preterm delivery	2 (8.0)	6 (24.0)	3.63 (0.66–20.12)	0.247
Any maternal complication	4 (16.0)	11 (44.0)	4.12 (1.09–15.59)	0.062

Table IV shows the fetal and neonatal outcomes according to study group. The mean birth weight was higher in Group II than in Group I (3226 ± 468 vs. 3018 ± 412 g). Low birth weight, macrosomia, large-for-gestational-age birth, neonatal hypoglycemia, Polyhydramnios, and NICU admission were more frequent among women in Group II. Any adverse neonatal outcome occurred in 40.0% of Group II compared with 16.0% of Group I.

Table IV
Fetal and neonatal outcomes according to study group.

Fetal/neonatal outcome	Group I n (%)	Group II n (%)	OR (95% CI)	p-value
Mean birth weight (g), mean ± SD	3018 ± 412	3226 ± 468	—	0.102
Low birth weight	3 (12.0)	4 (16.0)	1.40 (0.28–7.00)	1
Macrosomia	1 (4.0)	4 (16.0)	4.57 (0.47–44.17)	0.349
Small-for-gestational-age	2 (8.0)	2 (8.0)	1.00 (0.13–7.72)	1
Large-for-gestational-age	2 (8.0)	5 (20.0)	2.88 (0.50–16.48)	0.417
Polyhydramnios	1 (4.0)	4 (16.0)	4.57 (0.47–44.17)	0.349
Neonatal hypoglycemia	1 (4.0)	5 (20.0)	6.00 (0.65–55.66)	0.19
NICU admission	2 (8.0)	6 (24.0)	3.63 (0.66–20.12)	0.247
Stillbirth	0 (0.0)	1 (4.0)	Not estimable	1
Any adverse neonatal outcome	4 (16.0)	10 (40.0)	3.50 (0.92–13.31)	0.114

Table V shows pregnancy outcomes according to the type of moderate elevation. Gestational hypertension and preeclampsia were more frequent among women with moderate BP elevation or combined BP and glucose elevation. Gestational diabetes mellitus and neonatal hypoglycemia were more frequent among women with moderate glucose elevation and combined elevation. Cesarean delivery and NICU admission also showed higher frequencies across the moderate-elevation groups.

Table V
Pregnancy outcomes according to the type of moderate elevation.

Pregnancy outcome	No elevation (n=25)	BP elevation (n=13)	Glucose elevation (n=8)	BP + glucose elevation (n=4)	p-value
Gestational hypertension	1 (4.0)	3 (23.1)	0 (0.0)	2 (50.0)	0.023
Preeclampsia	1 (4.0)	2 (15.4)	0 (0.0)	2 (50.0)	0.038
Gestational diabetes mellitus	1 (4.0)	1 (7.7)	3 (37.5)	1 (25.0)	0.043
Cesarean delivery	9 (36.0)	7 (53.8)	5 (62.5)	3 (75.0)	0.36
Preterm delivery	2 (8.0)	3 (23.1)	1 (12.5)	2 (50.0)	0.124
Neonatal hypoglycemia	1 (4.0)	1 (7.7)	3 (37.5)	1 (25.0)	0.043
NICU admission	2 (8.0)	3 (23.1)	2 (25.0)	1 (25.0)	0.362

Table VI shows the multivariable logistic regression analysis of factors associated with adverse pregnancy outcomes. Maternal age ≥30 years, BMI ≥25 kg/m², moderate BP elevation, and moderate glucose elevation were associated with increased adjusted odds, although their associations were not statistically significant. Combined moderate BP and glucose elevation showed an adjusted OR of 4.91 (95% CI: 1.01–23.78, p=0.049).

Table VI
Multivariable logistic regression analysis of factors associated with adverse pregnancy outcome.

Predictor	Adjusted OR	95% CI	p-value
Maternal age ≥30 years	1.72	0.54–5.48	0.356
BMI ≥25 kg/m²	2.41	0.78–7.43	0.126
Moderate BP elevation	2.86	0.87–9.39	0.083
Moderate glucose elevation	2.74	0.74–10.17	0.13
Combined moderate BP + glucose elevation	4.91	1.01–23.78	0.049

DISCUSSION

The present study investigated pregnancy outcomes among women with and without moderate elevations in blood pressure and/or blood glucose. The principal finding was that women with moderate BP and/or glucose elevation experienced a greater frequency of several adverse maternal and neonatal outcomes than women without moderate elevation. Although several individual associations did not reach statistical significance, the overall pattern suggests that moderate cardiometabolic abnormalities may identify women with a higher burden of adverse pregnancy outcomes.

In the present study, women with moderate BP and/or glucose elevation had a significantly higher mean BMI than those without moderate elevation (26.0 ± 3.1 vs. 24.1 ± 2.8 kg/m², p=0.028). This observation is consistent with the prospective Ugandan cohort of Milln et al., which specifically investigated moderate elevations in BP and blood glucose during pregnancy. Among 2,857 women, maternal obesity was independently associated with large birthweight, cesarean delivery, and neonatal admission.[1] Similarly, Moon et al. reported among women with gestational glucose intolerance or GDM that higher prepregnancy BMI was associated with increased odds of LGA birth, while insulin resistance was associated with LGA and cesarean delivery.[16] These findings support the importance of maternal adiposity as an accompanying metabolic risk factor among women with moderate cardiometabolic abnormalities.

Mean systolic BP, diastolic BP, and blood glucose were significantly higher in Group II than in Group I (all p<0.001). Recent evidence suggests that pregnancy-related BP risk may increase across BP categories rather than appearing only after the conventional hypertension threshold is reached. Slade et al., in a systematic review of BP categories during the first half of pregnancy, reported a stepwise association between increasing ACC/AHA BP

categories and preeclampsia.[3] Their subsequent systematic review of BP categories in the second half of pregnancy also found associations between higher BP categories and adverse pregnancy outcomes, although the strength of association was greatest at higher BP categories.[17] These findings support consideration of moderate BP elevation as a potential marker of increased pregnancy risk while maintaining the distinction between risk classification and formal hypertension diagnosis.

Evidence from South Asia is particularly relevant to the present Bangladeshi population. Nisar et al. conducted a population-based cohort study including women from Bangladesh, Pakistan, and Tanzania and found that the use of ACC/AHA BP categories identified additional women with lower-range hypertension compared with conventional criteria. In the Bangladesh population, ACC/AHA-defined hypertension was associated with increased risk of stillbirth, although the predictive performance of the lower BP categories for stillbirth and preterm birth was limited.[5] These findings suggest that lower BP categories may provide useful risk information but should not automatically be considered equivalent to conventional diagnostic hypertension.

In the present study, gestational hypertension occurred in 20.0% of women in Group II compared with 4.0% in Group I, while preeclampsia occurred in 16.0% and 4.0%, respectively. Although these individual differences were not statistically significant, the direction of association is consistent with recent observational evidence. Woolcock et al. reported that women who developed elevated BP or stage 1 hypertension after 20 weeks had increased odds of hypertensive disorders of pregnancy compared with women with normal BP.[18] Similarly, Mphaphuli et al. found that women presenting with stage 1 hypertension before 20 weeks had greater progression to stage 2 hypertension and increased postpartum antihypertensive use, although several other pregnancy outcomes were not significantly different.[6] Therefore, the present findings support continued surveillance of women with moderately elevated BP while avoiding the interpretation that all such women will develop hypertensive disease.

The frequency of GDM was higher among women with moderate BP and/or glucose elevation than among those without moderate elevation (20.0% vs. 4.0%). Although this difference was not statistically significant in the present study, the observed direction is consistent with evidence that intermediate glycemic levels may identify women at increased risk of subsequent GDM and other pregnancy complications. Bhattacharya et al., in a 2024 systematic review and meta-analysis of 16 studies involving 115,899 pregnancies, found that first-trimester fasting plasma glucose ≥5.1 mmol/L was associated with subsequent GDM, preeclampsia, gestational hypertension, LGA, and macrosomia.[19] These findings support the clinical relevance of intermediate glucose elevations even before conventional diagnostic criteria for GDM are fulfilled.

The broader relationship between GDM and adverse pregnancy outcomes is also supported by recent systematic reviews. Mahmoud et al. reported significant associations between GDM and several adverse maternal and neonatal outcomes using contemporary diagnostic criteria.[20] Similarly, Ye et al., in a systematic review and meta-analysis including more than 7.5 million pregnancies, found that GDM was associated with increased odds of cesarean delivery, preterm birth, macrosomia, and LGA birth.[10] Although the present study assessed moderate glucose elevation rather than established GDM, the higher frequencies of GDM, macrosomia, LGA, and neonatal hypoglycemia in Group II are directionally consistent with this broader evidence.

Cesarean delivery and preterm birth were more frequent in Group II than Group I, occurring in 60.0% versus 36.0% and 24.0% versus 8.0%, respectively. However, neither difference was statistically significant. Milln et al. reported that hyperglycemia in the GDM range was associated with cesarean delivery, while stage 1 hypertension showed a positive but nonsignificant association with preterm birth.[8] In addition, Xiao et al., in a systematic review and meta-analysis involving 303,131 pregnancies, found that stage 1 hypertension was associated with increased odds of preterm delivery, small-for-gestational-age birth, low birth weight, and early-term delivery.[21] The lack of statistical significance in the present study may partly reflect its small sample size and limited number of outcome events.

The fetal and neonatal findings showed a similar overall pattern. Mean birth weight was higher in Group II than Group I (3226 ± 468 vs. 3018 ± 412 g), while macrosomia, LGA, neonatal hypoglycemia, and NICU admission were more frequent in Group II. Polyhydramnios may also be relevant when evaluating antenatal complications associated with maternal cardiometabolic abnormalities. Perak et al., using data from the HAPO study, demonstrated that gestational cardiovascular health—incorporating BMI, BP, glucose, lipids, and smoking—was associated with adverse maternal and newborn outcomes.[11] In addition, Durnwald et al. reported that pregnancies resulting in LGA neonates or complicated by hypertensive disorders had slightly higher mean glucose levels and greater time spent above specified glucose thresholds, even when findings were considered across pregnancies with and without GDM.[22] These observations are compatible with the higher birthweight and adverse neonatal outcome frequencies observed in the present moderate-elevation group.

The higher frequency of neonatal hypoglycemia in Group II is also compatible with evidence linking maternal glycemic characteristics to neonatal glucose disturbances. Zhang et al., in a prospective cohort of 322 women with GDM, reported neonatal hypoglycemia in 19.57% of neonates and found that maternal 1-hour postprandial glucose was independently associated with neonatal hypoglycemia.[23] Because that study involved women with established GDM, it is not directly comparable with the moderate glucose-elevation group in the present study. Nevertheless, it provides supporting evidence for the biological relationship between maternal glucose levels and neonatal hypoglycemia.

The analysis according to the type of moderate elevation demonstrated a clinically recognizable pattern. Gestational hypertension and preeclampsia were more frequent among women with moderate BP elevation or combined BP and glucose elevation, whereas GDM and neonatal hypoglycemia were more frequent among women with moderate glucose elevation. The combined BP-plus-glucose group showed particularly high frequencies of several outcomes. However, only four women were included in this subgroup. Therefore, the corresponding percentages are unstable and should be interpreted as descriptive observations rather than definitive evidence of differential risk.

The multivariable analysis showed increased adjusted odds of adverse pregnancy outcomes among women with moderate BP elevation and moderate glucose elevation, although these individual associations were not statistically significant. Combined moderate BP and glucose elevation was associated with an adjusted OR of 4.91 (95% CI: 1.01–23.78, p=0.049). This finding suggests a potentially greater burden of risk when BP and glucose abnormalities coexist. However, the wide confidence interval and the very small number of women with combined elevation indicate considerable statistical uncertainty. Therefore, this finding should be considered exploratory and requires confirmation in a larger study.

Contemporary evidence also emphasizes the importance of identifying and managing clinically relevant BP abnormalities during pregnancy. The CHAP randomized trial demonstrated that treatment targeting BP below 140/90 mmHg in women with established mild

chronic hypertension improved pregnancy outcomes without increasing the risk of small-for-gestational-age birth.[12] However, the CHAP population consisted of women with chronic hypertension and therefore differs from the women with moderate, subdiagnostic BP elevations in the present study. Consequently, the CHAP findings provide contextual evidence regarding BP-related pregnancy risk but should not be directly extrapolated to the present exposure definition.

Overall, the findings of the present study are broadly consistent with international evidence indicating that maternal cardiovascular and metabolic risk may extend across a continuum rather than being confined to conventional diagnostic thresholds. The findings are also relevant to Bangladesh, where recent population-based evidence has demonstrated that lower BP categories identify additional women with elevated cardiovascular risk but have limitations in predicting individual adverse pregnancy outcomes.[5] The present study therefore suggests that moderate BP and glucose elevations may have potential value as early risk markers when interpreted together with BMI and other maternal characteristics.

The study has several limitations. The sample size was small, participants were recruited purposively from a single district hospital, and the cross-sectional design limits assessment of temporal relationships between moderate elevations and subsequent pregnancy outcomes. The small number of outcome events resulted in wide confidence intervals, particularly for subgroup and multivariable analyses. In addition, the combined BP-plus-glucose subgroup included only four participants, limiting reliable estimation of its associated risks. Larger prospective multicenter studies involving Bangladeshi women are needed to determine whether moderate BP and glucose elevations independently predict adverse maternal, fetal, and neonatal outcomes and to establish clinically useful thresholds for risk stratification.

LIMITATIONS

This study was limited by its small sample size, single-center setting, and purposive sampling, which may restrict the generalizability of the findings. The small subgroup with combined BP and glucose elevation also limited reliable subgroup analysis. Larger multicenter prospective studies are needed to validate these findings.

CONCLUSION

The present study suggests that moderate elevations in blood pressure and/or blood glucose may be associated with a greater burden of adverse maternal and neonatal outcomes among pregnant women. Women with moderate elevations had higher BMI and more frequent gestational hypertension, preeclampsia, GDM, cesarean delivery, preterm birth, macrosomia, LGA birth, neonatal hypoglycemia, and NICU admission, although several individual associations were not statistically significant. Combined moderate BP and glucose elevation showed higher adjusted odds of adverse pregnancy outcomes, but this finding should be interpreted cautiously because of the small sample size and wide confidence interval. These findings support the potential value of early recognition and closer antenatal surveillance of women with moderate cardiometabolic abnormalities. Larger prospective multicenter studies in Bangladesh are needed to confirm these associations and establish clinically meaningful thresholds for identifying women at increased risk.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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