Original Article

Association of Overweight and Obesity with Hypertensive Disorders of Pregnancy in Bangladeshi Women: A Hospital-Based Case-Control Study

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Abstract

Background: *Prevalence of Hypertensive disorders of pregnancy (HDP) is ≈ 5 to 10 % worldwide. In Bangladesh it was estimated ≈ 10 to 15%. HDP are leading cause of maternal mortality and other adverse feto-maternal outcome of pregnancy. Overweight & obesity has been recognized as an important risk factor for HDP in studies conducted in developed countries, but there is a scarcity of evidence from Bangladesh.* ***Objective:*** *The objective of this study was to determine the association of overweight and obesity with HDP, and to evaluate potential confounding factors.* ***Materials and Methods:*** *It was an observational analytic study with case-control design conducted in the period of January 2026 to June 2026. Data was collected by face to face interview, physical examination and going through medical records using a structured questionnaire. Descriptive and analytic statistics was conducted using IBM SPSS Statistics 25.* ***Results:*** *Adjusted odds ratio (AOR) for age = 1.126 (95% CI: 1.065 - 1.189, p <0.001); for gravidity AOR = 1.133 (95% CI: 0.561 – 2.286, p =0.728). AOR for gestational diabetes mellitus (GDM) was 6.482 (95% CI: 1.631 - 25.769, p =0.008), and AOR for overweight & obesity = 3.023 (95% CI: 1.675 - 5.454, p <0.001).* ***Conclusion:*** *Overweight or obese individuals are 3.023 times more likely to develop HDP when compared to subjects with normal BMI (< 25 kg/m²) after adjusting for age, gravidity, and GDM. Emphasizing modifiable risk factors such as overweight and obesity can reduce HDP induced maternal morbidity and mortality.*

Keywords: Hypertensive disorders, Pregnancy; Body mass index; Overweight; Obesity; Gestational diabetes mellitus; Risk factors.

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Introduction

Hypertensive disorders of pregnancy (HDP) are the leading causes of maternal morbidity and mortality worldwide, remarkably in low and middle-income countries.[1,2] Globally, 5% to 10% of all pregnancies are complicated with HDP.[3] Despite advances in antenatal care (ANC), HDP continue to contribute to maternal deaths, preterm births, intrauterine growth restriction (IUGR), stillbirths, and other adverse neonatal outcomes.[4]

The scenario is worse in developing countries like Bangladesh where access to quality ANC is limited, diagnosis is delayed, and resources for management are inadequate.[5] According to previous studies conducted in Bangladesh, 10% to 15% of maternal deaths were due to HDP.[6] This was also associated with an increased risk of preterm delivery, IUGR, perinatal mortality, and cesarean delivery. Despite ongoing efforts to improve maternal health services, HDP continue to inflict significant clinical and economic burdens on the healthcare system of Bangladesh.[7]

HDP comprises gestational hypertension, preeclampsia, severe preeclampsia, eclampsia, chronic hypertension with superimposed preeclampsia and HELLP syndrome. Gestational hypertension is defined as new onset hypertension (BP ≥140/90 mmHg) after 20 weeks of pregnancy without proteinuria or any other features of preeclampsia. Preeclampsia is categorized as newly developed (gestational age >20 weeks) hypertension with proteinuria (≥300 mg/24 hour or dipstick reading of 2+) or, in the absences of proteinuria, maternal end organ dysfunction. Severe preeclampsia is diagnosed as preeclampsia complicated with systolic BP ≥160 mmHg and diastolic BP ≥110 mmHg with one or

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more severe features including evidence of hepatic dysfunction, persistent abdominal pain, progressive renal impairment, platelet count < 100000/µL, pulmonary edema or visual disturbance. Eclampsia includes patients with new onset seizures in preeclamptic cases that cannot be explained by another neurologic or metabolic cause.[8] New onset proteinuria or maternal end organ dysfunction in subjects with chronic hypertension (hypertension diagnosed before 20 weeks of pregnancy) is defined as chronic hypertension with superimposed preeclampsia.[8,9] HELLP syndrome is defined by the presence of hemolysis, elevated liver enzymes, and low platelet count (<100000/µL).[8,10]

Obesity is one of the most well-known modifiable risk factors for undesirable pregnancy outcomes both for the mother and her baby. Overweight and obesity in women of reproductive age have remarkably increased over the last few decades.[11,12] Excess adipose tissue deposition contributes to chronic inflammation, insulin resistance, endothelial dysfunction and altered placental vascular development, all of which are concerned in the pathogenesis of HDP.[12] Many systematic reviews and meta-analyses have demonstrated a strong positive association between high pre-pregnancy body mass index (BMI) and the risk of developing HDP. A recent meta-analysis involving more than 50 million pregnancies demonstrated that each 5 kg/m² increase in pre-pregnancy BMI was associated with a ≈ 75% to 82% higher risk of HDP including preeclampsia. Studies have also shown that maternal adiposity indicators measured in early pregnancy are significant predictors of developing HDP.[13,14]

High BMI has been recognized as an important risk factor for HDP in studies conducted in developed countries, but there is a scarcity of evidence from Bangladesh.[15,16] Available Bangladeshi studies on HDP have primarily focused on prevalence, clinical characteristics, maternal outcomes, and perinatal outcomes rather than evaluating obesity as an independent risk factor.[15,17] Furthermore, the relationship between pre-pregnancy BMI defined overweight & obesity with HDP among Bangladeshi women has not been adequately investigated using an analytical epidemiological design such as a case-control study. There is also a scarcity of hospital-based evidence from the southwestern part of Bangladesh. Conducting this study in Ad-din Sakina Medical College Hospital (ASMCH), Jashore, which serves a large population of pregnant women from both urban and rural settings, was expected to be insightful.

Materials and Methods

This was an observational analytical study with a case-control design conducted in ASMCH, Jashore from January 2026 to June 2026. Clearance and approval was taken from the institutional review board (IRB) of Ad-din Sakina Women's Medical College (ASWMC) and ASMCH authority to conduct the study. Informed written consent was taken from each subject after explaining the study procedures and its implication. Confidentiality of data was ensured. No intervention was done. No experimental animal was involved in the study.

A non-probability consecutive sampling technique was used until target sample size for case and control group was achieved. Sample size was estimated to be 266 (Case = 92 / Control = 174) at CI = 95%, Power = 80% and Ratio = 1:2 using Epi Info™ (Desktop Version) for unmatched case-control study. All our study subjects (cases & controls) were volunteer singleton pregnant women of more than 20 weeks of gestational age from the outpatient and inpatient facilities of ASMCH, Jashore.

We included cases with a confirmed diagnosis of hypertensive disorders of pregnancy (HDP), which comprised gestational hypertension, preeclampsia, severe preeclampsia, eclampsia, chronic hypertension with superimposed preeclampsia, and HELLP syndrome. Controls included otherwise healthy pregnant women from

the same facilities. Overweight & Obesity was defined collectively as a BMI ≥25 kg/m² for subjects aged >19 years according to World Health Organization (WHO).[18] Age and sex specific growth reference chart was employed for subjects aged ≤ 19 years for defining overweight & obesity.[19] BMI was calculated using pre-pregnancy weight (kg) and height(m) of subjects from medical records. Any subjects with multiple pregnancies, gestational age ≤20 weeks, with any chronic medical disorder, severely sick and who refused to participate in the study was excluded.

Data were collected from face-to-face interviews, clinical examination and medical records. A structured data collection form captured sociodemographic details (age, residence, income, education), obstetric history (gravidity, parity, ANC visits, previous HDP), and health data, including pre-pregnancy BMI and symptoms such as recent onset visual disturbance and edema. Clinical measurements, including blood pressure and pulse were recorded. Lab reports regarding proteinuria, CBC with platelet count and liver and renal function tests were reviewed to distinguish HDP.

Statistical analysis was performed using IBM SPSS Satistics™ to summarize subject characteristics and assess associations. Descriptive statistics outlined baseline data, while bivariate analyses using chi-square tests explored relationships between risk factors (independent variables) and HDP. Student t test and Mann Whitney U test (wherever appropriate) was performed for parametric data to compare between case and control group. We used unconditional binary logistic regression to model HDP (case group) versus the control group (comparison group), adjusting for age, gravidity, GDM, and overweight & obesity. Logistic regression identified independent risk factors, with adjusted odds ratio (AOR) quantifying associations.

Results

In this case control study, among 266 study subjects, 92 was incorporated in the case group and 174 in the control group. Majority of the study subjects came from Jashore sadar thana (37.0% of cases and 38.5% of controls). We had subjects from 19 different thana of Jashore, Jhenaidah, Satkhira, Chuadanga and Narail district (Figure 1).

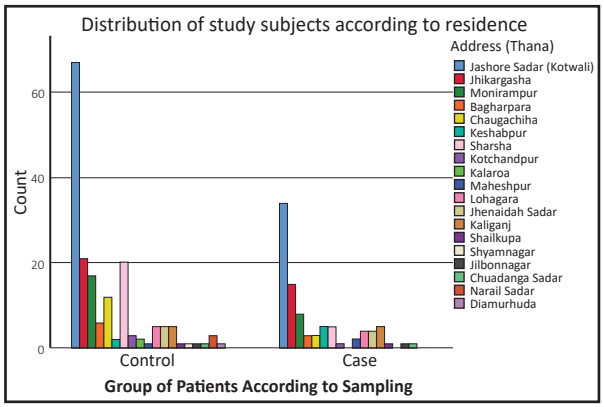

Figure 1: Distribution of study subjects according to residence.

Age of our subjects ranged from 15 years to 45 years. Mean age ±SD of the case group was 28.67 ±6.23 years and for control group this was 24.32 ±5.44 years. Mean age of cases appeared to be higher significantly (p <0.001) when compared to control group of our study. Considering age groups, there was also significant differences among cases and controls in between <20 years age group, 20-35 years age group and >35 years age group in our study (p <0.001), which is displayed in table 1.

41.3% of cases and 36.8% of controls used to live in urban areas and 58.7% of cases and 63.2% of controls in rural areas respectively. Statistically there were no significant (p =0.471) differences in respect of living in rural or urban areas among cases and controls (Table 1).

In view of household monthly income of the family they belonged was (mean ±SD) 34,467.39

±16,295.66 BDT vs 38,017.24 ±24,953.71 BDT in case and control group respectively and there was no significant (p =0.164) difference statistically (Table 1). After categorizing monthly income into low (>30000 BDT), middle (30000 to 80000 BDT) and high (>80000 BDT) income group; there was also no significant (p = 0.400) difference statistically among the case and control group (Table 1).

Taking Institutional education into account, majority of case and control group subjects belonged to SSC (34.8% vs 40.2%) and HSC (50.1% vs 39.1%) group respectively (Figure 2). The differences among case and control groups based on institutional education appeared not to be significant (p = 0.115) statistically (Table 1).

Table 1: Siciodemographic characteristics of the study subjects (n=266)

Variables		Case (n=92)	Control (n=174)	p value
Age (years)		28.67 ±6.23	24.32 ±5.44	<0.001
Age Group	<20 years	5 (5.4%)	37 (21.3%)	
	20 - 35 years	77 (83.7%)	133 (76.4%)	
	>35 years	10 (10.9%)	4 (2.3%)	<0.001
Residence	Urban	38 (41.3%)	64 (36.8%)	
	Rural	54 (58.7%)	110 (63.2%)	0.471
Household Monthly Income (BDT)		34467.39 ±16295.66	38017.24 ±24953.71	0.164
Income Group	Low (<30000 BDT)	53 (57.6%)	90 (51.8%)	
	Middle (30000-80000 BDT)	48 (41.3%)	78 (44.8%)	
	High (>80000 BDT)	1(1.1%)	6 (3.4%)	0.400
Institutional Education	None	1 (0.9%)	0 (0.0%)	
	Primary	3 (3.3%)	17 (9.8%)	
	SSC	32 (34.8%)	70 (40.2%)	
	HSC	46 (50.1%)	68 (39.1%)	
	Graduate & Above	10 (10.9%)	19 (10.9%)	0.115

n; number of subject, Parametric data was expressed as mean ± standard deviation (SD) and categorical data was expressed as frequency (percentage). p <0.05 was considered as level of significance at 95% confidence interval. Independent sample t-test and Mann Whitney U test (whenever appropriate) was performed for parametric data and Chi-square test for categorical data.

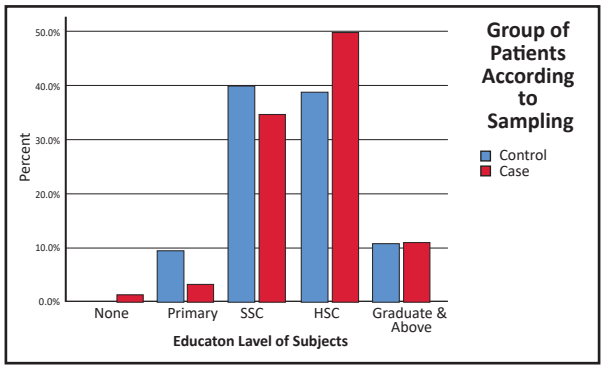

Figure 2: Bar chart showing education level of the subjects according to sampling.

Mean ±SD BMI (kg/m2) of the case group (24.93 ±3.68) was significantly (p <0.001) higher than the control group (22.16 ±3.43). Taking overweight & obesity (BMI ≥25 kg/m2) into account, case group showed fairly higher percentages (48.9% vs 23.0%) than the control group. Mean ±SD BMI of case and control group according to different age group is shown in a box and plot chart (Figure 3). The difference was also significant (p <0.001) statistically (Table 2).

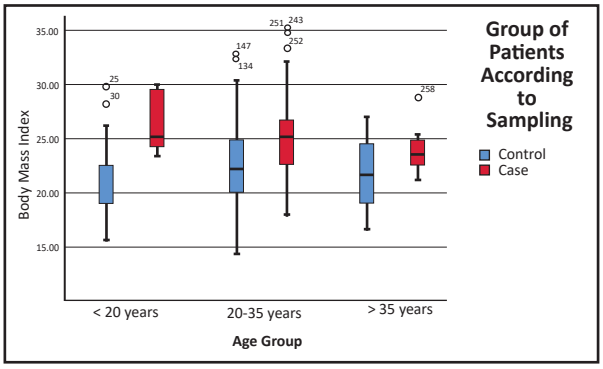

Figure 3: Box and plot chart showing body mass index (BMI) of different age group according to sampling. Horizontal line within the box indicates the median value.

14.1% subjects of the case group was diagnosed as GDM while in the control group comprised only 1.7% of subjects with GDM. It was evident that GDM among cases was significantly (p <0.001) higher when compared with the controls. Mean ±SD of gestational age during data collection was 33.52 ± 3.88 weeks vs 32.71 ± 5.90 weeks among case and control group respectively. Gestational age of the subjects appeared to be similar and statistically there was no significant (p =0.153) difference when compared (Table 2).

Considering number of pregnancies including the current one (gravida), the mean ±SD gravida of the cases was 2.54 ±1.19 and 1.97 ±1.12 for controls. The difference was statistically significant (p <0.001) and indicated an association of HDP (case) with increasing number of pregnancies. Conversely 78.3% of the case group subjects were multigravida and 57.5% subjects of control group were multigravida. Only 21.7% of cases were primigravida and 42.5% of controls were primigravida. The predominance of multigravidity among cases was significant (p =0.001) statistically (Table 2).

The exponential of regression coefficient [Exp(B)] for the variable 'age' was 1.126 (95% CI: 1.065 to 1.189, p <0.001); the odds of having HDP (case) increases by 12.6% with each year increase in subject's age. Exp(B) or adjusted odds ratio (AOR) for gravidity was 1.133 but was not significant statistically (p =0.728). Exp(B) or AOR for GDM was 6.482 (95% CI: 1.631 to 25.769, p =0.008), which is a significant finding. Exp(B) or AOR for overweight & obesity (BMI ≥25 kg/m2) was 3.023 (95% CI: 1.675 to 5.454, p <0.001); overweight or obese are 3.023 times more likely to develop HDP compared to non-obese (BMI <25 kg/m2) subjects after adjusting for age, gravidity and GDM (Table 3).

Table 2: Anthropometric and clinical characteristics of the study subjects (n=266)

Variables		Case (n=92)	Control (n=174)	p value
BMI (kg/m^2)		24.93 ±3.68	22.16 ±3.43	<0.001
Overweight & Obesity	No	47 (51.1%)	134 (77.0%)	
	Yes	45 (48.9%)	40 (23.0%)	<0.001
GDM	No	79 (85.9%)	171 (98.3%)	<0.001
	Yes	13 (14.1%)	3 (1.7%)	
Gestational Age (weeks)		33.52 ±3.88	32.71 ±5.90	0.153
Gravida		2.54 ±1.19	1.97 ±1.12	<0.001
Gravidity	Primigravida	20 (21.7%)	74 (42.5%)	
	Multigravida	72 (78.3%)	100 (57.5%)	0.001

n; number of subject, BMI; Body mass index, GDM; Gestational diabetes mellitus, Parametric data was expressed as mean ± standard deviation (SD) and categorical data was expressed as frequency (percentage). p <0.05 was considered as level of significance at 95% confidence interval. Independent sample t-test was performed for parametric data and Chi-square test for categorical data.

Table 3: Result of the logistic regression analysis showing contribution of the independent variables in predicting HDP in our study.

Independent Variables	B	Exp(B) or AOR	95% CI of Exp(B)		*Significance (p value)*
			Lower	Upper	
Age	0.118	1.126	1.065	1.189	<0.001
Gravidity	0.125	1.133	0.561	2.286	0.728
GDM	1.869	6.482	1.631	25.769	0.008
Overweight & Obesity	1.106	3.023	1.675	5.454	<0.001

HDP; Hypertensive disorders of pregnancy, GDM; Gestational diabetes mellitus, B; Logistic regression coefficient, Exp(B); Exponential B, AOR; Adjusted odds ratio, , CI; Confidence interval, p <0.05 was considered as level of significance at 95% CI.

Hosmer-Lemeshow goodness-of-fit test was non-significant (p =0.663) indicating the model was a good fit for prediction. The area under the receiver-operating characteristic (ROC) curve was 0.756 (95% CI: 0.695 to 0.817, p <0.001), which is an indication of acceptable discriminating accuracy of our logistic regression model.

Discussion

Primary objective of this study was to determine the association between BMI-defined overweight and obesity with HDP. The study aimed to determine the odds of HDP among overweight and obese women. It also tried to identify other confounding factors of HDP as well as making comparisons between cases and controls.

This case-control study was conducted in ASMCH, Jashore which is a tertiary care hospital, providing quality maternal and child health care support in an affordable cost. Majority of participants came from different thana of Jashore district. Some of them came from neighboring Jhenaidah, Satkhira, Chuadanga and Narail district. There was no significant (p =0.471) difference in respect of living in rural or urban areas among case and control group of our study subjects. Mean ±SD of gestational age of our study subjects was 33.52 ± 3.88 weeks vs 32.71 ± 5.90 weeks among case and control group respectively. Gestational age of the subjects was similar in both group and statistically non-significant (p =0.153). In our study, average household monthly income was 34,467.39 BDT and 38,017.24 BDT among case and control group respectively. Our observation was more or less consistent with Bangladesh household income and expenditure survey.[20] Although among control group the average monthly income was higher; the difference was not significant statistically. In the context of institutional education majority of subject completed either SSC or HCS exam and there was no significant statistical difference among case and control group.

The principle exposure of our study was pre-pregnancy overweight and obesity (BMI ≥25 kg/m^2). We found the mean BMI of the case group was significantly higher than the control group. Taking overweight & obesity into account, case group showed fairly higher percentages (48.9% vs 23.0%) than the control group. Xiong et al., in a very recent systematic review and dose-response meta-analysis involving 157 cohort studies and >51.8 million pregnancies also found a strong positive association between increasing pre-pregnancy BMI and pregnancy-induced hypertension, preeclampsia, eclampsia and overall HDP. Xiong et al, also showed adjusted OR of 1.75 (95% CI: 1.68–1.82) for HDP per 5-unit increase in BMI.[13] In our logistic regression analysis, we calculated the adjusted OR for overweight & obesity as 3.023 (95% CI: 1.675 to 5.454, p <0.001) after adjusting for subject's age, gravidity and GDM. Duckitt & Harrington, in a systematic review found that raised pre-pregnancy BMI was associated with increased risk of preeclampsia (RR

2.47, 95% CI: 1.66-3.67).[21] Salma U (2022) in her case-control study from Bangladesh also found significantly higher basal BMI among women with preeclampsia compared with normal pregnant controls (p =0.002).[22] A systematic review by Bartsch et al. also identified pre-pregnancy BMI >30 kg/m² as a major risk factor for preeclampsia (RR 2.8 95% CI: 2.6–3.1).[23] Our study findings is directionally consistent with previous studies in respect of BMI as well as overweight & obesity.

In this study, age of the subject was significantly higher among HPD cases (Case: Control = 28.67 ± 6.23: 24.32 ± 5.44 years). There was also significant differences among the three age categories (p <0.000). Salma U, in her study demonstrated mean age of 24.71 ± 2.56 years among preeclampsia women compared with 23.09 ± 2.1 years among controls, with a significant difference (p=0.005).[22] Saccone et al. and Duckitt et al. showed, women aged ≥40 years had significantly greater risk of preeclampsia and several other adverse outcomes.[21,24] Age remained an independent predictor in our logistic regression with an AOR = 1.126 (95% CI 1.065–1.189, p<0.001) indicating each one-year increase in age was associated with approximately 12.6% higher odds of HDP in our adjusted model. A recent prediction study by Xi Q et al., also identified maternal age as an independent predictor of preeclampsia, although its population and model differed from us.[25] The independent association of maternal age with HDP in our study is broadly consistent with previous multivariable prediction studies.

14.1% of cases (HPD) and 1.7% of controls in this study was found to have GDM and the difference was statistically significant (p <0.000). A systematic review specifically examining GDM and adverse pregnancy outcomes in South Asia conducted by Mistry SK et al. found that GDM was positively associated with preeclampsia.[26] Findings of this study strongly align with our findings. Our adjusted analysis calculated an AOR = 6.482 (95% CI 1.631–25.769, p =0.008) indicating that after adjustment women with GDM had approximately 6.5-fold higher odds of HDP. As the number of subjects with GDM was small (13 cases and only 3 controls), the confidence interval was wide, indicating considerable statistical uncertainty and the estimation of association should be interpreted with caution.

In our study gravidity was significantly higher among HDP cases (Mean gravida: 2.54 ±1.19 vs 1.97 ±1.12, p <0.001). 78.3% of the cases were multigravida and 57.5% controls group were multigravida. Only 21.7% of cases were primigravida and 42.5% of controls were primigravida. AOR for gravidity was 1.133, p=0.728, meaning that gravidity was not independently associated with HDP after adjustment. It was clearly evident that our finding of a greater proportion of multigravidas among HDP cases is not necessarily consistent with the classical literatures. For instance, Duckitt and Harrington found nulliparity to be associated with increased preeclampsia risk (RR 2.91, 95% CI 1.28–6.61).21

Our study included several key variables in our analysis; some unmeasured confounding factors may still influence the results. Some sociodemographic data like monthly income, institutional education, was self-declared and we had no scope to verify. This was a hospital based study, although ASWMCH is an affordable hospital for middle and lower-middle income group of subject; nationally representative sampling is required to generalize the study outcome.

Conclusion

Pre-pregnancy overweight and obesity are independently associated with threefold higher odd of hypertensive disorders of pregnancy among Bangladeshi women. Identification and programmed intervention in modifiable factors, particularly excess body weight, may help to reduce the burden of HDP and its associated maternal morbidity and mortality.

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