Is Obesity a Risk Factor for Pregnancy Induced Hypertension ?

Shurooq Awad Abdul Hussain [(1) *], Methal Abdul Radha Alrubaee [(2)], Nibras Ali Raheem [(3)]

1. MBChB. Basrah Maternity and Childhood Hospital, Basrah, Iraq.
2. Assistant Professor and consultant of Obstetrics and Gynaecology, College of Medicine, University of Basrah, Basrah, Iraq.
3. Specialist Obestetrician and Gynecologist, Basrah Health Directorate, Basrah, Iraq.

Corresponding Author - Dr Shurooq Awad Abdul Hussain

***Abstract*—Pregnancy-induced hypertension (PIH) is a significant obstetric complication associated with increased maternal and perinatal morbidity and mortality. Obesity has been increasingly recognized as a major and potentially modifiable risk factor for hypertensive disorders of pregnancy. This prospective case–control study was conducted at Al-Mawani Hospital from December 2024 to August 2025 to assess the association between maternal obesity and PIH. A total of 240 pregnant women admitted to the labour room were enrolled, including 80 women diagnosed with PIH and 160 normotensive controls matched for age and parity. PIH diagnosis was established through clinical evaluation and laboratory investigations. Maternal body mass index (BMI) was calculated using pre-pregnancy weight, and gestational weight gain was recorded. Statistical analysis was performed using SPSS version 26. Among women with PIH, 41 cases (51.2%) had gestational hypertension, and 39 cases (48.8%) had pre-eclampsia. Obesity (BMI ≥30 kg/m²) was significantly more prevalent in the PIH group, affecting 37 women (46.3%), compared with only 6 women (3.8%) in the control group (p=0.001). Normal BMI was observed in 17.5% of hypertensive women versus 40% of normotensive women. Excessive gestational weight gain (>12 kg) occurred in 12.5% of women with PIH compared to 2.5% of controls (p=0.048). Among obese women with PIH, 18 out of 37 (48.6%) delivered by caesarean section, whereas all obese normotensive women had vaginal deliveries (p=0.007). No significant difference in gestational weight gain was found between obese women with and without PIH (p=0.919). In conclusion, obesity was strongly associated with pregnancy-induced hypertension and increased rates of caesarean delivery. These findings support the importance of early BMI screening, weight management, and targeted antenatal interventions to reduce PIH-related complications.**

Keywords: Pregnancy-induced hypertension, Obesity, Body mass index, Gestational weight gain, Preeclampsia

INTRODUCTION

Pregnancy-induced hypertension (PIH) is defined by the World Health Organization as blood pressure ≥140/90 mmHg developing after 20 weeks of gestation (1). It is broadly classified into gestational hypertension, pre-eclampsia, and eclampsia. Gestational hypertension is defined by the American College of Obstetricians and Gynaecologists (ACOG) as systolic blood pressure ≥140 mmHg or diastolic ≥90 mmHg on two occasions at least four hours apart after 20 weeks in previously normotensive women (2).

Pre-eclampsia is a multisystem disorder characterized by new-onset hypertension with or without proteinuria, usually occurring after 20 weeks of gestation (3), while eclampsia represents the onset of seizures in women with hypertensive disorders of pregnancy in the absence of other neurological causes, commonly occurring intrapartum or postpartum (4). Based on severity, PIH is classified into mild, moderate, and severe according to systolic and diastolic blood pressure thresholds (5). PIH significantly contributes to maternal and neonatal morbidity and mortality, accounting for approximately 15% of maternal deaths in the United States, with an overall prevalence of 5–10% of pregnancies (1).

Globally, pre-eclampsia affects 2–8% of pregnancies, with rising incidence attributed to advanced maternal age and increasing pre-pregnancy obesity, while eclampsia rates have declined due to improved antenatal care and timely interventions (6,7).

The aetiology of PIH is multifactorial and includes placental abnormalities (8), immune maladaptation (9), endothelial dysfunction (10), hormonal imbalance (11), and physiological vascular changes of pregnancy (12). Several risk factors have been identified, including primigravidity (13), family history of hypertensive disorders (14), extremes of maternal age (15), obesity (16), multiple gestations (13), chronic hypertension and medical comorbidities (13), previous history of PIH (13), and adverse lifestyle factors such as smoking and physical inactivity (17).

Diagnosis of PIH follows ACOG criteria, with specific thresholds for blood pressure and proteinuria or evidence of end-organ dysfunction (2,18,19). Eclampsia and HELLP syndrome represent severe complications, defined by characteristic clinical and laboratory features including haemolysis, elevated liver enzymes, and thrombocytopenia (20).

Obesity, defined as excessive adipose tissue accumulation that increases health risks, is a growing global public health problem (21). Maternal obesity is increasingly prevalent and associated with significant short- and long-term maternal and fetal complications (22,23), with pregnancy itself acting as a trigger for further weight gain (24). The prevalence of obesity in pregnancy ranges from 30–40%, varies by ethnicity, and continues to rise worldwide (22,25–27).

Obesity in pregnancy increases maternal risks such as gestational diabetes, hypertensive disorders, thromboembolism, labour complications, operative delivery, and anaesthesia-related risks (28–31), as well as foetal and neonatal complications including miscarriage, stillbirth, congenital anomalies, and macrosomia (29–32). Obesity contributes to PIH through increased cardiovascular strain (33), insulin resistance and metabolic dysfunction (34), chronic inflammation and oxidative stress (35), hormonal dysregulation (36), higher prevalence of pre-existing diseases (37), and impaired placental function (38). Preventive strategies include preconception counselling, lifestyle modification, and close antenatal monitoring to reduce the risk and severity of PIH (39).

The aim of this study is to determine whether obesity is a significant predisposing factor for the development of pregnancy-induced hypertension in the form of gestational hypertension and pre-eclampsia.

METHODS

A prospective case–control study was conducted at Al-Mawani Hospital over the period from 1 December 2024 to 1 August 2025. The study population comprised 240 pregnant women who were admitted to the labour room during the study period. Participants were allocated into two groups: 80 women diagnosed with pregnancy-induced hypertension (PIH) constituted the case group, while 160 normotensive pregnant women served as the control group. The two groups were matched for maternal age and parity to minimize confounding factors.

The diagnosis of PIH was established based on a comprehensive clinical assessment, which included a detailed medical history focusing on the onset of hypertension during pregnancy and any antihypertensive treatment received. Clinical examination involved accurate measurement of blood pressure and assessment for physical signs suggestive of PIH. Laboratory investigations included urine analysis to detect albuminuria and blood tests to evaluate renal and liver function in order to assess disease severity.

Eligible participants were gravid women with a documented pre-pregnancy body weight and a confirmed onset of hypertension during the late second or third trimester, determined by accurate estimation of gestational age based on a known last menstrual period. Women were excluded from the study if they had unknown pre-pregnancy weight, pre-existing chronic hypertension, established or gestational diabetes mellitus, multiple pregnancy, uncertain onset of hypertension due to delayed or absent antenatal care, or a history of chronic renal disease.

For all participants, current body weight and height were measured at the time of admission. Body mass index (BMI) was calculated using the formula: pre-pregnancy body weight in kilograms divided by height in meters squared. Gestational weight gain was estimated by subtracting the pre-pregnancy weight from the current body weight. Based on BMI values, participants were classified as underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), obese class I (30–34.9 kg/m²), obese class II (35–39.9 kg/m²), or obese class III (≥40 kg/m²) (40).

Data on maternal age, parity, gestational age, type of PIH, antenatal care attendance, obstetric and medical history, and mode of delivery were collected from all participants using a structured questionnaire form.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26. Qualitative variables were expressed as frequencies and percentages. Appropriate statistical tests were applied, with the chi-square test used for analysis of categorical variables, and Fisher's exact test employed when expected cell counts were less than five. A p-value of ≤0.05 was considered statistically significant in all analyses.

RESULTS

Out of 80 cases diagnosed to have PIH, 51.2% had gestational hypertension and 48.8% had preeclampsia.

Table (1): Types of PIH

Types	No.	%
Preeclampsia	39	48.8
Gestational hypertension	41	51.2
Total	80	100.0

Regarding the age distribution of both case and control groups, the majority belonged to the young age group (18-34 years), (78.5%) in the case group and (77.5%) in the control group, with no significant difference since p-value is (>0.05). Also, there was no significant difference regarding the parity, as about half of both groups had (1-4 deliveries) (47.5%) in the group case and (51.9%) in the control group, with a p-value (> 0.05).

Table (2): Demographic features of the study groups

Demographic feature	Case		Control		p-value
	No.	%	No.	%	
Age					
<18 years	2	2.5	5	3.1	0.605
18-25 years	30	37.5	73	45.6	
26-34 years	28	35.0	51	31.9	
≥ 35 years	20	25.0	31	19.4	
Total	80	100.0	160	100.0	
Parity					
Primigravida	22	27.5	47	29.4	0.431
1-4	38	47.5	83	51.9	
≥ 5	20	25.0	30	18.8	
Total	80	100.0	160	100.0	

Only (17.5%) of hypertensive women had normal BMI compared to (40%) in normotensive women, while (46.3%) of hypertensive patients were obese since their BMI was >30 including class I, II, III compared to only (3.8%) of the control with highly significant difference as p-value is (<0.01).

Table (3): Distribution of the study groups according to BMI

BMI	Case		Control		p-value
	No.	%	No.	%	
Normal (18.5-24.9)	14	17.5	64	40.0	0.001
Overweight (25-29.9)	29	36.3	90	56.3	
Obese class I (30-34.9)	24	30.0	6	3.8	
Obese class II(35-39.9)	10	12.5	0	0.0	
Obese class III (≥40)	3	3.8	0	0.0	
Total	80	100.0	160	100.0	

Among hypertensive women, they had average weight gain (i.e. 10-12 kg) in (53.8%) compared to (69.4%) in normotensive women. About (12.5%) of the case group gained weight exceeding (12 kg) compared to only (2.5%) in the control, with a significant p-value (i.e. <0.05).

Table (4): Weight gain during pregnancy among both groups

Weight gain (kg)	Case		Control		p-value
	No.	%	No.	%	
8 kg	9	11.2	14	8.7	0.048
9 kg	18	22.5	31	19.4	
10 kg	19	23.8	47	29.4	
11 kg	10	12.5	31	19.4	
12 kg	14	17.5	33	20.6	
13 Kg	6	7.5	4	2.5	
14Kg	3	3.7	0	0	
15 Kg	1	1.3	0	0	
Total	80	100.0	160	100.0	

Regarding weight gain among obese women of both hypertensive and normotensive groups, there was no significant difference since (54%) of the cases had average weight gain (i.e.10-12 kg) compared to (66.7%) of the control. Only 24.3% of obese hypertensive women had excess weight gain.

Table (5): Weight gain during pregnancy among obese women in both groups

Weight gain (kg)	Case		Control		p-value
	No.	%	No.	%	
8 kg	2	5.4	1	16.7	**0.919**
9 kg	6	16.2	1	16.7	
10 kg	9	24.3	2	33.3	
11 kg	5	13.5	1	16.7	
12 kg	6	16.2	1	16.7	
13 kg	5	13.5	0	0.0	
14 kg	3	8.1	0	0.0	
15 kg	1	2.7	0	0.0	
Total	37	100.0	6	100.0	

The rate of caesarean section was high among obese hypertensive women (48.6%) with a highly significant difference (i.e. p<0.01) compared to normotensive women.

Table (6): Mode of delivery among obese women in both groups

Mode of delivery	Case		Control		p-value
	No.	%	No.	%	
Normal Vaginal Delivery (NVD)	19	51.4	6	100.0	0.007
Cesarean Section (CS)	18	48.6	0	0.0	
Total	37	100.0	6	100.0	

DISCUSSION

Pregnancy-induced hypertension (PIH) remains a major obstetric complication associated with increased maternal and perinatal morbidity and mortality worldwide (1). PIH encompasses a spectrum of hypertensive disorders including gestational hypertension and preeclampsia, both of which may have serious consequences if not appropriately managed (41). Understanding the demographic, clinical, and lifestyle-related risk factors associated with PIH is essential for improving early detection and intervention strategies, particularly in resource-limited settings such as Iraq.

This prospective case-control study aimed to identify key characteristics associated with PIH, including body mass index (BMI), weight gain during pregnancy, and mode of delivery, while ensuring proper matching for age and parity between cases and controls. The findings highlight the significant role of obesity and excessive gestational weight gain as modifiable risk factors for hypertensive disorders in pregnancy.

Our study showed that among the 80 women diagnosed with PIH, (51.2%) had gestational hypertension while (48.8%) had preeclampsia, reflecting an almost equal distribution between the two subtypes. This pattern is consistent with international evidence, where Garovic et al. (2022) (42) highlighted gestational hypertension and preeclampsia as the predominant forms of PIH worldwide, and Khan et al. (2022) (43) similarly emphasized the significant burden of preeclampsia in terms of both incidence and adverse maternal–neonatal outcomes. Moreover, Muti et al. (2015)(44) reported nearly comparable proportions of gestational hypertension and preeclampsia among women in Zimbabwe, further reinforcing the generalizability of our findings across diverse populations. Our study is also in line with a local literature from Iraq by Fadhil et al. (2024) (45) indicating that gestational hypertension often accounts for the majority of hypertensive disorders during pregnancy, especially in populations with high obesity rates and limited access to early antenatal care (46). The near-equal distribution between gestational hypertension and preeclampsia in this study suggests that both forms of PIH remain clinically relevant and should be addressed equally in preventive care and this is in agreement with the recommendations from Agarwal et al. (2024) (47).

There were no statistically significant differences between the case and control groups regarding age and parity ($p > 0.05$) which is intended for matching to reduce the effect of confounders. The majority of participants in both groups fell within the 18–34 year age range, accounting for (78.5%) in the case group and (77.5%) in the control group. This aligns with findings from other regional studies indicating that PIH can occur across a wide reproductive age range, not solely in older pregnant women (48).

A striking difference was observed in BMI distribution between hypertensive and normotensive women. Only (17.5%) of women in the hypertensive group had a normal BMI, compared to (40%) in the normotensive group. Conversely, (46.3%) of women with PIH were obese (BMI > 30), compared to only (3.8%) of the control group—a difference that was highly significant ($p = 0.001$). This is consistent with Abraham et al. (2022) (49), who identified obesity as strongly associated with preeclampsia and emphasized its role in risk stratification. Similarly, Pizano-Zarate et al. (2023) (50) demonstrated that maternal overweight and obesity not only elevate the likelihood of PIH but also increase the risk of long-term cardiometabolic complications following a preeclamptic pregnancy. According to Spradley et al. (2015), obesity is associated with increased systemic inflammation, endothelial dysfunction, and altered angiogenic profiles, all of which contribute to the pathogenesis of gestational hypertension and preeclampsia (51). Furthermore, a higher BMI often correlates with insulin resistance and other metabolic abnormalities that exacerbate hypertensive risk during pregnancy as supported by the evidence from Catalano et al. (2010) (34).

In terms of weight gain during pregnancy, the majority of normotensive women gained between 10–12 kg (69.4%), while only (53.8%) of hypertensive women fell within this range. Notably, (12.5%) of women with PIH gained more than 12 kg, compared to just (2.5%) of normotensive women, with a statistically significant difference ($p = 0.048$). Excessive gestational weight gain, particularly among women already overweight or obese, has been independently associated with increased risk of preeclampsia and gestational hypertension. This finding aligns with those of Macdonald-Wallis et al. (2013), who reported that both pre-pregnancy BMI and excessive weight gain are synergistically linked to hypertensive complications in pregnancy (52). It emphasizes the need for early nutritional counselling and weight monitoring in antenatal care programs.

Although no significant difference in weight gain was noted among obese women in the case and control groups ($p = 0.919$), a meaningful clinical difference was observed in the mode of delivery. Among obese hypertensive women, (48.6%) underwent caesarean section, whereas all normotensive obese women had vaginal deliveries ($p = 0.007$). This finding is consistent with the broader literature by Hamm et al. (2021) and Ellis et al. (2019) showing that PIH, particularly in the context of obesity, significantly increases the likelihood of cesarean delivery due to poor

cervical readiness, failed induction, and maternal or fetal distress (53, 54). The combination of high BMI and PIH poses additional anesthetic and surgical risks, further complicating delivery outcomes (31).

The findings from this study highlight several important clinical and public health considerations. Firstly, obesity and excessive gestational weight gain are both prevalent and modifiable risk factors for PIH. Secondly, the increased likelihood of cesarean delivery among obese women with PIH underscores the need for multidisciplinary care involving obstetricians, dietitians, and anesthetists. Thirdly, while demographic features like age and parity did not significantly differ between cases and controls, targeting weight management before and during pregnancy may offer the greatest impact on reducing PIH risk.

While this study provides valuable insights, certain limitations must be acknowledged. The sample size, though adequate, may limit generalizability to other populations. Additionally, self-reported pre-pregnancy weight—used to calculate BMI—may introduce recall bias, although efforts were made to include only women with known weight.

CONCLUSION AND RECOMMENDATIONS

The present study concludes that gestational hypertension and preeclampsia were almost equally prevalent among women with pregnancy-induced hypertension, emphasizing the clinical importance of both conditions. Obesity, defined as a pre-pregnancy BMI ≥30 kg/m², was significantly more common in women with PIH compared with normotensive controls, confirming obesity as a major predisposing factor. Excessive gestational weight gain was also more frequent among women with PIH and showed a significant association with hypertensive complications. Additionally, obese women with PIH had a higher rate of caesarean delivery, indicating an increased likelihood of surgical intervention when obesity and PIH coexist. However, no significant difference in gestational weight gain was observed between obese women with and without PIH, suggesting that pre-pregnancy BMI may play a more influential role than weight gain during pregnancy alone. Based on these findings, routine BMI assessment should be incorporated into antenatal care to enable early identification of women at increased risk of PIH. Targeted nutritional guidance and lifestyle counselling before and during pregnancy are recommended for women with elevated BMI to reduce hypertensive complications. Close monitoring of gestational weight gain, particularly in overweight and obese women, alongside education on healthy diet and physical activity, is essential. Early and regular antenatal follow-up for high-risk women should be prioritized to facilitate timely detection and management of hypertensive disorders, and multidisciplinary care involving obstetricians, dietitians, and anaesthetists is advised to minimize maternal and neonatal complications.

Conflicts of Interests: None

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