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# ASSOCIATION OF INTRA-UTERINE GROWTH RESTRICTION WITH PREGNANCY INDUCED HYPERTENSION

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## ABSTRACT

**Background:** Pregnancy-induced hypertension (PIH) is one of the most common causes of morbidity and mortality among pregnant women and their fetuses internationally. The impaired uteroplacental perfusion in the case of PIH impairs fetal growth causing intrauterine growth restriction (IUGR) that leads to adverse perinatal outcomes.
**Objective:** To determine the prevalence of intrauterine growth restriction (IUGR) among pregnant women and to assess the association between intrauterine growth restriction and pregnancy-induced hypertension (PIH).
**Methods:** This was a Comparative Cross-sectional study that was carried out Department of obstetrics & Gynecology, Allama Iqbal Teaching Hospital DG Khan, from March 2026 to June 2026. Comprising 146 patients with PIH and 146 normotensive pregnant women. Women aged 20–40 years with singleton pregnancies of 37 weeks gestation or over, but less than 5 parities at time of enrollment were recruited using non-probability consecutive sampling. Standardized antenatal ultrasound scan was performed on a normal timeframe by an experienced radiologist, blinded to the hypertensive status of the mother, to assess fetal growth. Data were collected on demographic and obstetric features, and analyzed using SPSS version 23. The Chi-square test, odds ratios (ORs) with 95% confidence intervals (CIs) and stratified analyses were used to evaluate associations.
**Results:** IUGR was identified in 41.1% (60/146) of women with PIH compared with 8.2% (12/146) of normotensive women ($p<0.001$). The odds of IUGR were significantly higher for women with PIH (OR 7.85; 95% CI: 3.98–15.48). This association was also observed after stratification for maternal age, parity, obesity and gestational diabetes ($p<0.05$). The mean birth weight was also significantly lower for neonates born to mothers with PIH than for the control mothers.
**Conclusions:** There is a strong association between intrauterine growth restriction and pregnancy-induced hypertension. However, early detection, careful surveillance and early management of PIH can significantly improve IUGR-related adverse outcomes of the perinatal period. These data call for further large-scale multicenter prospective studies to confirm them.

**KEYWORDS:** Pregnancy-induced hypertension (PIH) – Intrauterine growth restriction (IUGR), Preeclampsia, Fetal growth restriction, Hypertensive disorders of pregnancy (HDP), Uteroplacental insufficiency, Fetal growth, Birth weight, Perinatal outcomes, Maternal hypertension.

## 1. INTRODUCTION

In general, 10% of pregnancies may develop pregnancy-induced hypertension (PIH) [1]. PIH is diagnosed in previously normotensive women when their systolic BP is greater than 140 mmHg and/or their diastolic BP is greater than 90 mmHg at 20 weeks of gestation or thereafter [2]. PIH increases the risk of adverse maternal outcomes such as placental abruption, stroke, failure of multiple organs and disseminated intravascular coagulation [3].
Treatment of hypertensive disorders during pregnancy is still difficult, and no best treatment has been consistently found, presenting obstetricians with little guidance in evidence-based clinical decision making. Eclampsia is a condition associated with seizures and is an advanced stage of pre-eclampsia (PE) which is a syndrome that can develop from pregnancy-induced hypertension and occurs in women with a significant risk of maternal and foetal morbidity and mortality [4]. Ambulatory blood pressure monitoring, the measurement of blood pressure over a 24-

hour period has become a valuable adjunct in forecasting the development of disease from gestational hypertension to pre-eclampsia [5].

Intrauterine growth restriction (IUGR) is a serious neonatal health problem and is more common in developing countries where more than 20% of the population suffers from IUGR indicating a need for specific public health measures [6]. Maternal factors particularly hypertension disorders during pregnancy are important in the pathogenesis of IUGR. It is crucial to identify the underlying causes of FGR to prevent fetal growth restriction-related perinatal morbidity and mortality. Preeclampsia and IUGR are known to be the major factors contributing to poor perinatal outcome [7].

Lu et al. carried out a cohort study of 773 preterm births and found that 18.4% of women had PIH. The mean birth weight of infants born from a hyper- or normotensive mother differed significantly (1522.1 ± 348.8 g vs. 1683.4 ± 345.3 g; $p < 0.001$). There were women with IUGR in 19.3% of the hypertensive women and 3.1% of normotensive women while PIH was found to have a very high risk of developing IUGR (OR 8.402; 95% CI: 4.350–16.227) [8].

In the same way, the study of Qayyum et al. was a six-month long cohort study with 240 pregnant women categorized as PIH and normotensive women. A higher number of growth-restricted fetuses were found in the PIH group (39.2%) versus the normotensive group (10.8%) in the study. Pregnancy-induced hypertension was associated with a 3.6-fold increased risk of IUGR (RR = 3.6154; 95% CI: 2.065–6.327; $p < 0.05$) [9].

The aim of the present study was to ascertain the prevalence of IUGR in women attending the antenatal clinic with pregnancy induced hypertension. Despite the consistent findings from all over the world that there is a strong correlation between PIH and IUGR, there are not enough local studies that have measured the extent to which this is occurring in our population. This proof of this relationship could be useful for obstetricians in our context to better control blood pressure in pregnancy, thus minimizing fetal growth restriction and the associated morbidity and mortality.

### 1.1 OBJECTIVE

To determine the prevalence of intrauterine growth restriction (IUGR) among pregnant women and to assess the association between intrauterine growth restriction and pregnancy-induced hypertension (PIH).

## 2. METHODOLOGY

This was a Comparative Cross-sectional study that was carried out Department of obstetrics & Gynecology, Allama Iqbal Teaching Hospital DG Khan, from March 2026 to June 2026. A total of 292 pregnant women (146 with PIH and 146 normotensive controls) were recruited using non-probability consecutive sampling method. Women aged 20-40 years, singleton pregnancy >37 weeks gestation and parity <5 were included. History, clinical examination and appropriate laboratory investigations were undertaken. The fetal biometry was measured by ultrasound using a consultant radiologist with more than 3 years experience in post-fellowship, who was not aware of the hypertensive status of the participants. Information on all variables namely demographic data, BMI, obesity status, Gestational diabetes, IUGR (estimated fetal weight<10th centile) was documented on a proforma.

### 2.1 INCLUSION CRITERIA

Pregnant women between 20-40 years old, with singleton pregnancy, who presented at over 37 weeks of gestation and less than 5 parity were included.

### 2.2 EXCLUSION CRITERIA

Pregnant women with pre-existing chronic hypertension (blood pressure ≥140/90 mmHg), premature rupture of membranes, abnormal placental implantation (placenta previa, placenta accreta, or placenta increta) or placental abruption. The clinical history and medical record were used to identify these conditions and women who fell into these categories were excluded from the study.

### 2.3 DATA COLLECTION PROCEDURE

With permission of the institutional ethics review committee, 292 women were asked to participate in the study upon reaching the outpatient department after giving informed written consent and were enrolled that were eligible for pregnancy. With permission from the institutional ethics review committee, 292 women were enrolled who were eligible for pregnancy after obtaining written informed consent upon presentation at the outpatient department. Baseline data such as age, gestational age, parity, gravida, weight, height, BMI, obesity, confirmed gestational diabetes (two-step OGTT) were recorded. A consultant radiologist, unaware of the PIH status, carried out ultrasound examination to assess fetal growth parameters by the operational definition of IUGR (estimated fetal weight < 10th centile for gestation). All the findings and the presence of hypertension were documented on a pre-designed proforma. Throughout the process, strict confidentiality was maintained.

### 2.4 DATA ANALYSIS

The collected data was entered and analyzed in SPSS version 23.0. Normality of continuous variables (age, gestational age and BMI) was tested by the Shapiro-Wilk test and values expressed as mean ± standard deviation. Categorical variables (parity, gravida, obesity, gestational diabetes, IUGR) were presented as frequencies and percentages. Assessment of association between IUGR and PIH was done by the chi square test which was statistically significant at the $p \leq 0.05$ level. Odds ratios and 95% confidence intervals were determined. Stratification was carried out among age groups, gestational age, parity, gravida, obesity and gestational diabetes. Effect modification was assessed by post-stratification chi-square tests.

## 3. RESULTS

This comparative cross-sectional study recruited 292 pregnant women, 146 women with pregnancy induced hypertension and 146 normotensive pregnant women. The average maternal age of the study population was 28.9 ± 4.8 years, and the average gestational age when the study participants joined was 38.6 ± 0.9 weeks. Both groups had similar maternal factors at baseline.

**Table 1. The baseline characteristics of the study population (n = 292) are presented below.**

| Characteristics | PIH (n=146) | Normotensive (n=146) | Total (n=292) |
|---|---|---|---|
| **Maternal age (years), Mean ± SD** | 29.1 ± 4.7 | 28.7 ± 4.9 | 28.9 ± 4.8 |
| **Gestational age (weeks), Mean ± SD** | 38.5 ± 0.8 | 38.7 ± 0.9 | 38.6 ± 0.9 |
| **Parity, Mean ± SD** | 2.4 ± 1.2 | 2.2 ± 1.1 | 2.3 ± 1.2 |
| **Obesity, n (%)** | 34 (23.3) | 29 (19.9) | 63 (21.6) |
| **Gestational diabetes, n (%)** | 18 (12.3) | 15 (10.3) | 33 (11.3) |

Demographic and obstetric parameters were similar in both study groups.

**Table 2. The proportion of babies that suffered from Intrauterine Growth Restriction (IUGR).**

| Study Group | IUGR Present n (%) | IUGR Absent n (%) | Total | p-value |
|---|---|---|---|---|
| **PIH** | 60 (41.1) | 86 (58.9) | 146 | |
| **Normotensive** | 12 (8.2) | 134 (91.8) | 146 | <0.001 |
| **Total** | 72 (24.7) | 220 (75.3) | 292 | |

Overall, 72 (24.7%) women had fetuses diagnosed with IUGR. The frequency of IUGR was significantly higher in women with PIH than in normotensive controls (41.1% vs. 8.2%; $p < 0.001$).

**Table 3. Association between pregnancy induced hypertension and IUGR is presented.**

| Untransformed scales | OR (Odds Ratio) | 95% CI (Confidence Interval) | p-value |
|---|---|---|---|
| **Pregnancy-Induced Hypertension** | 7.85 | 3.98–15.48 | <0.001 |

The odds of intrauterine growth restriction were 7.85 times greater in women with pregnancy induced hypertension than in normotensive pregnant women.

**Table 4. Comparing the Birth Weight of Newborns Across Groups**

| PIH (n=146) | Normotensive (n=146) | Mean Difference | p-value | |
|---|---|---|---|---|
| **Birth weight (g), Mean ± SD** | 2487 ± 412 | 3124 ± 378 | −637 g | <0.001 |

The mean birth weight of neonates to mothers with PIH was significantly smaller than that of newborns to normotensive mothers.

**Table 5. The association between PIH and IUGR was analyzed stratified for the age of the babies.**

| Stratification Variable | p-value |
|---|---|
| **Maternal age** | 0.002 |
| **Parity** | 0.011 |
| **Obesity** | 0.018 |

| | |
|---|---|
| **Gestational diabetes mellitus** | 0.041 |
| **Interaction between PIH and hypertension during pregnancy** | 0.0276 |

The relationship between PIH and IUGR was also significant for all maternal age, parity, obesity and gestational diabetes mellitus (all $p < 0.05$) after stratification. There was no significant interaction between PIH and gestational diabetes ($p = 0.120$) suggesting that the risk for fetal growth restriction was independently associated with PIH.

**Interpretation**

In the present study, high association between pregnancy induced hypertension and intrauterine growth restriction was found. There was a significantly higher prevalence of IUGR and lower birth weight in infants of women with PIH than in normotensive women. The association persisted after adjustment for main maternal risk factors, indicating that PIH is an independent risk factor for impaired fetal growth. The results are in line with those found in high impact obstetric literature in SCIE and Pubmed and highlight the need for recognition and best practice of high blood pressure in pregnancy to optimize perinatal outcomes.

## 4. DISCUSSION

High blood pressure complications of pregnancy remain a major problem in the world in relation to maternal and perinatal morbidity and mortality. During pregnancy, severe hypertension is a life-threatening condition for the mother because it can destabilize her cardiovascular system, and can have detrimental effects on her fetus, making early diagnosis and treatment very important [1]. Improved clinical monitoring and laboratory assessments have improved the ability to stratify patients, but remain challenging in predicting the severity of the disease.

Recent studies have demonstrated the value of the use of haematological and biochemical markers in the identification of severity of gestational hypertension and preeclampsia. Plasma biochemical levels alterations may be a sign of endothelial dysfunction and systemic inflammation, which are crucial in the disease process [2]. Pathophysiologically, it is becoming evident that preeclampsia is a multisystem disease that is characterized by abnormal placentation, cardiovascular maladaptation, and molecular signal abnormalities [3].

In particular, early onset preeclampsia is linked to an increased risk for low birth weight and admission to the NICU and a negative impact on neonatal outcomes is a concern [4]. Therefore, assessment of blood pressure has become more significant, even for ambulatory monitoring for better maternal management and minimising fetal risk [5].

Pregnancy-induced hypertension (PIH) is very related with intrauterine growth restriction (IUGR) that indicates impaired uteroplacental perfusion. IUGR is a polyetiological condition which has several risk factors in the mother and obstetrics [6]. The role of oxidative stress in this process is essential and it is the linkage of these processes with the hypertensive disorders with placental dysfunction and the bad outcomes of the pregnancy such as foetal growth restriction and premature delivery [7].

This association of pregnancy-induced hypertension and adverse fetal outcomes also has been validated in cohorts of preterm infants, particularly for early and moderate preterm delivery [8]. This association is also supported by regional studies which show a high co-existence of IUGR and hypertensive disorders in tertiary care centres [9].

Pre-eclampsia is physiopathologically characterized by an abnormally developing placenta, immune dysfunction and endothelial damage that results in the involvement of multiple maternal organs and impaired fetal growth [10]. The importance of early detection of LFS is therefore a screening priority and the importance of reducing the risk of stillbirth and neonatal morbidity will be emphasized [11].

These changes in the cardiovascular system in these women have been determined to be possible indicators of fetal growth restriction, which is characterized as an inability of the mother's cardiovascular system to supply the demands of pregnancy [12]. The current international consensus is that definition of SGA and FGR fetuses based on standard diagnostic criteria and structured surveillance protocols to improve perinatal outcomes are more important [13].

The timely intervention, along with screening and tailored care pathways is essential for preventing SAB in FGR [14]. NIPP is evolving: there are new and emerging tools to help identify pregnancies at risk [15].

Additionally, biochemical markers are of great interest because biochemical ratios of metabolites in maternal serum can be predictive of fetal growth restriction at term as a basis for precision obstetrics [16]. Outcome based assessment and management of FGR has been further enhanced by harmonisation of diagnostic definitions by the different professional bodies [17].

Comprehensive screening, accurate diagnosis and customized management strategies for fetal growth restriction and its complications are now stressed by best practices recommendations from international organizations [18]. Other adjunctive tests such as Doppler ultrasound are also useful for the assessment of placental insufficiency and fetal well-being that are available in resource limited settings [19].

## 5. CONCLUSION

This study is in agreement of the significant association between pregnancy-induced hypertension and intrauterine growth restriction, with the risk of IUGR being almost eight times higher if the mother has pregnancy-induced hypertension. The study highlights the importance of careful surveillance, timely detection and optimal management of HDP during pregnancy to prevent fetal growth restriction and associated perinatal morbidity. Educating obstetricians can result in early interventions in resource-limited environments like ours, including more intensive monitoring of the fetus, delivering at the right time and making lifestyle changes. Additional public health interventions that target early antenatal care and control of modifiable risk factors (obesity, gestational diabetes) may help further reduce the burden. The local evidence in this study is useful; however, future, more detailed, long-term studies are needed to confirm these findings and to develop evidence-based protocols. Overall, integrated maternal fetal care is a crucial component to better the outcomes for mothers and infants.

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