

Clinical Profiles and Maternal–Neonatal Outcomes in Pregnancies Complicated by Hypertensive Disorders in Puerto Rico and gave Birth at the University District Hospital between 2020-2023

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Objectives: To characterize clinical profiles of mothers and neonates in Puerto Rico affected by hypertensive disorders of pregnancy and evaluate associated maternal and neonatal outcomes.

Methods: We performed a retrospective review of patients seen at the high-risk clinic of the University District Hospital in Puerto Rico (2020–2023). Patients were excluded if they did not deliver a live infant or delivered at an outside hospital. Clinical and demographic data were extracted from medical records and grouped by hypertensive status. Descriptive statistics summarized maternal history, delivery outcomes, and neonatal data. Associations were analyzed using Chi-square, Fisher's exact test, and Wilcoxon-Mann-Whitney tests, with significance set at $P \leq 0.05$.

Results: Among 278 mothers, 40.3% ($n = 112$) had a hypertensive disorder, including chronic hypertension (40%) and preeclampsia (22%). Higher maternal BMI was significantly associated with all hypertensive disorders. Chronic hypertension was strongly associated with preeclampsia, conferring 4.8-fold higher odds (95% CI: 2.36–9.75). Hypertensive disorders were linked to earlier gestational age at delivery but not to increased cesarean delivery rates. Neonates of affected mothers had lower Apgar scores.

Conclusion: Hypertensive disorders were common and associated with higher BMI, increased risk of preeclampsia among patients with chronic hypertension, earlier delivery, and lower neonatal Apgar scores. These findings highlight the need for early identification, targeted management, and strengthened prenatal screening to reduce hypertension-related complications in high-risk populations in Puerto Rico.

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Key words: Hypertensive conditions in pregnancy, Preeclampsia, Chronic hypertension, Puertorrican population, High-risk pregnancy

Hypertensive disorders of pregnancy (HDP) are a leading cause of maternal and neonatal morbidity and mortality worldwide, affecting approximately 5% to 10% of pregnancies and contributing to adverse outcomes such as preterm birth, fetal growth restriction, and perinatal mortality (1-3). These disorders include chronic hypertension, gestational hypertension, and preeclampsia, each associated with varying degrees of maternal and neonatal risk. Chronic hypertension is a well-established risk factor for the development of preeclampsia and adverse perinatal outcomes (4,5). Disparities in the prevalence and severity of HDP have been documented across racial, ethnic, and geographic populations, often reflecting differences in cardiometabolic risk factors and access to prenatal care (6-8).

One of the most significant neonatal consequences associated with HDP is impaired fetal growth, commonly manifested as small for gestational age (SGA), defined as a birth weight below the 10th percentile for gestational age and sex (8). SGA is a major contributor to stillbirth, neonatal morbidity, and perinatal complications, and has been linked to long-term adverse health outcomes, including hypertension, diabetes, and obesity later in life (8-10). In Latin American populations, infants born SGA have a significantly higher risk of neonatal mortality compared with those

born appropriate for gestational age, underscoring the importance of targeted, population-specific research (11).

The development of SGA is multifactorial, arising from a complex interplay of maternal, fetal, uteroplacental, and sociodemographic factors. Maternal medical conditions, particularly chronic hypertension and pregnancy-induced hypertension, contribute to placental insufficiency through impaired uteroplacental blood flow, limiting fetal oxygen and nutrient delivery (4,5). Sociodemographic determinants such as socioeconomic status, maternal education, and access to prenatal care further influence SGA risk and contribute to disparities in perinatal outcomes (12).

Maternal nutritional status, frequently assessed by prepregnancy body mass index (BMI), has also been implicated in fetal growth

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outcomes. Underweight BMI is consistently associated with an increased risk of SGA, whereas the relationship between overweight or obesity and SGA remain inconsistent across studies, highlighting the complex metabolic and vascular mechanisms involved (13). Additionally, maternal age plays a critical role in SGA risk. Advanced maternal age (≥ 35 years) has been associated with higher rates of preterm SGA, while adolescent pregnancies are more commonly linked to term SGA births (14). Age-related physiological changes and the increased prevalence of comorbid conditions, including HDP and gestational diabetes mellitus, may further exacerbate fetal growth restriction.

Puerto Rico bears a disproportionate burden of obesity and cardiometabolic disease, which may amplify the risk and impact of hypertensive disorders in pregnancy (9-10). Contemporary data examining the combined effect of maternal HDP and associated comorbidities on neonatal outcomes, including SGA, remain limited in this population. Characterizing these relationships in Puerto Rico is essential to inform early risk identification, optimize prenatal surveillance, and develop targeted interventions to improve maternal and neonatal outcomes.

Materials and Methods

This study was a retrospective observational cohort study conducted at the high-risk obstetrics clinic of the University District Hospital, University of Puerto Rico Medical Sciences Campus, in Puerto Rico. The study included deliveries occurring between January 1, 2020, and December 31, 2023. The population was categorized as women living in Puerto Rico as all the patient's admitted in the study had an active address in Puerto Rico. The research protocol was approved by the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus (IRB protocol number 2402194437).

The study population consisted of pregnant patients evaluated at the high-risk clinic who had a second trimester anatomic sonogram during the study period. Patients were eligible for inclusion if they delivered a live-born infant at the University District Hospital. Patients were excluded if they did not result in a live birth or if delivery occurred at an external institution.

The primary exposure was the presence of a hypertensive disorder of pregnancy, categorized as chronic hypertension, preeclampsia, or preeclampsia with severe features. Chronic hypertension was defined as a documented diagnosis of hypertension prior to 20 weeks of gestation or the presence of two elevated blood pressure measurements before 20 weeks of gestation. Diagnoses of preeclampsia and preeclampsia with severe features were assigned in accordance with American College of Obstetricians and Gynecologists (ACOG) criteria.

Secondary maternal variables included the diagnosis of gestational diabetes mellitus, defined by an abnormal 1-hour glucose screening test followed by a diagnostic 3-hour 100-g oral glucose tolerance test. Delivery characteristics included mode of delivery, categorized as vaginal delivery, cesarean delivery, or assisted vaginal delivery using vacuum extraction. Neonatal outcomes included Apgar scores and the presence of congenital anomalies.

Clinical and demographic data were obtained from electronic medical records. All variables were abstracted using standardized

data collection procedures and classified according to hypertensive status. Diagnoses and outcomes were defined based on established clinical criteria to minimize misclassification.

To reduce selection bias, only patients with complete delivery data at the study institution were included. Use of standardized diagnostic criteria for hypertensive disorders and gestational diabetes mellitus was intended to reduce information bias inherent to retrospective data collection.

All eligible patients meeting the inclusion criteria during the study period were included. No a priori sample size or power calculation was performed due to the study's retrospective nature.

Descriptive statistics were used to summarize maternal demographic characteristics, medical history, delivery data, and neonatal outcomes. Categorical variables were compared using chi-square (χ^2) tests, Fisher's exact tests, and simple logistic regression to assess unadjusted associations with the presence of any hypertensive disorder. Continuous variables were compared using the Wilcoxon-Mann-Whitney rank-sum test. Statistical significance was defined as a two-sided p-value ≤ 0.05 . All analyses were performed using Stata version 14.2 (StataCorp, College Station, TX, USA).

Results

A total of 278 birthing patients met the inclusion criteria, of whom 40.3% ($n = 112$) were diagnosed with a hypertensive disorder of pregnancy. Among patients with hypertensive disorders, 22.0% were diagnosed with preeclampsia or preeclampsia with severe features.

The study cohort was characterized by a high prevalence of obesity and preexisting diabetes, and cesarean delivery was the most common mode of delivery. The normotensive patient cohort served as the control group in the study. The mean maternal body mass index (BMI) was 33 kg/m², the mean maternal age was 28 years, and the mean gestational age at delivery was 37 weeks. Table 1 shows maternal mean age, type of delivery and presence and type of diabetes. Higher maternal BMI was significantly associated with the presence of hypertensive disorders, with increasing BMI positively correlated with the development of all hypertensive conditions during pregnancy. Table 2 shows the BMI data for the study population. No significant association was observed between hypertensive disorders and gestational diabetes mellitus.

Hypertensive disorders were not associated with an increased likelihood of cesarean delivery. No significant association was identified between hypertensive disorders and intrauterine

Table 1. Mean age, diabetes status and type of delivery.

Mean maternal age	28
Vaginal delivery	99
Assisted vaginal delivery	15
Cesarean section	155
Diabetes type 1	17
Diabetes type 2	21

Table 2. Demographic data on maternal weight pre-pregnancy.

Body mass index characterization	Patient number (n=258)
Underweight (BMI <18.5)	4
Normal weight (BMI 18.5-24.9)	45
Overweight (BMI 25.0-29.9)	47
Class I Obesity (BMI 30.0-34.9)	52
Class II Obesity (BMI 35.0-39.9)	42
Class III Obesity (BMI 40.0 or greater)	68

growth restriction. A marginal association was observed between hypertensive disorders and small-for-gestational-age neonates; however, this association was no longer present after stratification by specific hypertensive diagnoses, including chronic hypertension and preeclampsia. Table 3 shows hypertensive demographic data in the study population.

Table 3. Hypertensive disorders observed in the studied population.

Type of hypertensive disorder	Patient number (n=278)
Gestational Hypertension	30
Chronic Hypertension	19
Preeclampsia	27
Preeclampsia with severe features	16
Chronic Hypertension with superimposed preeclampsia	7
Chronic Hypertension with preeclampsia with severe features	13
No Hypertensive disorder	166

Chronic hypertension was strongly associated with the development of preeclampsia. Patients with chronic hypertension had 4.8-fold higher odds of developing preeclampsia compared with those without chronic hypertension (95% confidence interval: 2.36–9.75). In multivariable logistic regression analysis adjusting for gestational age at delivery, chronic hypertension was not a significant predictor of cesarean delivery ($z = -0.63$, $p = 0.527$). Gestational age did not significantly contribute to the odds of cesarean delivery ($z = 0.86$, $p = 0.390$). Table 4 shows the gestational ages at which the population under study delivered. The overall model was not statistically significant ($n = 199$; likelihood ratio $\chi^2 = 1.93$; $p = 0.381$).

Neonates born to mothers with hypertensive disorders had lower Apgar scores compared with those born to normotensive mothers. Hypertensive disorders were not associated with the development of gestational diabetes mellitus.

Regarding clinical management, 85% of patients ($n = 238$) received antihypertensive therapy during pregnancy, most commonly labetalol or nifedipine. No cases of eclampsia were observed during the study period.

Table 4. Gestational ages at which the patients delivered.

Gestational age	Patient number (n=276)
24 0/7 – 27 6/7	4
28 0/7 – 31 6/7	9
32 0/7 – 33 6/7	7
34 0/7 – 36 6/7	32
37 0/7 – 41 6/7	224

Discussion

In this retrospective cohort study of a high-risk obstetric population of women living in Puerto Rico, hypertensive disorders of pregnancy affected more than 40% of birthing patients, a prevalence substantially higher than the 5% to 10% reported globally (1-3). This finding reflects both the referral-based nature of a high-risk clinic and the elevated burden of cardiometabolic risk factors within this population. Consistent with existing literature, chronic hypertension was strongly associated with the subsequent development of preeclampsia, reinforcing its role as a major contributor to adverse maternal and neonatal outcomes (4,5).

Maternal body mass index emerged as a significant risk factor for hypertensive disorders in this cohort, with higher BMI positively correlated with the development of all hypertensive conditions during pregnancy. This finding aligns with prior studies demonstrating a dose-dependent association between increasing BMI and hypertensive disorders of pregnancy (6-7). Obesity-related mechanisms, including insulin resistance, systemic inflammation, endothelial dysfunction, and impaired placentation, may contribute to abnormal uteroplacental blood flow and increased hypertensive risk (8). Given the high prevalence of obesity in Puerto Rico, these results underscore the importance of addressing maternal nutritional status as a modifiable risk factor.

Although hypertensive disorders were initially marginally associated with small-for-gestational-age (SGA) neonates, this association was not sustained after stratification by hypertensive subtype. This suggests that fetal growth restriction in the setting of hypertensive disorders may be heterogeneous and influenced by disease severity, chronicity, and clinical management. Prior studies have demonstrated that chronic hypertension and preeclampsia can impair uteroplacental perfusion, contributing to placental insufficiency and restricted fetal growth (4,5,8). However, the absence of a persistent association in this cohort may reflect effective antenatal surveillance, timely antihypertensive treatment, or competing influences of maternal BMI and gestational age at delivery. Considering current guidelines, most deliveries fell within the early term, which is expected in patients with diagnosis of preeclampsia.

Neonates born to mothers with hypertensive disorders had lower Apgar scores compared with those born to normotensive mothers, consistent with previous reports linking hypertensive disorders to compromised fetal oxygenation and perinatal adaptation (9,10,11). While hypertensive disorders are well-recognized contributors to

preterm birth and fetal growth restriction (1, 3), their impact on immediate neonatal outcomes may vary depending on access to specialized prenatal care and timely intervention.

Despite shared cardiometabolic risk factors, hypertensive disorders were not associated with gestational diabetes mellitus in this population. Prior literature has reported inconsistent associations between these conditions (12, 13), suggesting that although they may coexist, they likely arise from distinct pathophysiologic pathways. Additionally, hypertensive disorders were not associated with an increased likelihood of cesarean delivery, even after adjustment for gestational age, indicating that hypertensive status alone did not drive delivery mode decisions in this cohort.

Most patients received antihypertensive therapy during pregnancy, predominantly labetalol or nifedipine, consistent with current guideline-based management (14, 15). The absence of eclampsia cases likely reflects effective blood pressure control, early diagnosis, and close surveillance within a specialized high-risk clinical setting.

Puerto Rico bears a disproportionate burden of obesity, hypertension, and cardiometabolic disease, which intersect with pregnancy to amplify maternal and neonatal risk (16-19). Disparities in access to care, socioeconomic status, and chronic disease prevalence further compound these risks and contribute to population-level differences in hypertensive disorders of pregnancy and fetal growth outcomes (14-16). The high prevalence of hypertensive disorders observed in this cohort underscores the urgency of population-specific research aimed at early identification of high-risk pregnancies.

Importantly, infants born SGA in Latin American populations experience higher neonatal mortality compared with those born appropriate for gestational age, emphasizing the public health relevance of identifying modifiable contributors to fetal growth restriction (11). Although the association between hypertensive disorders and SGA was not robust in this cohort, the intersection of maternal hypertension, obesity, and sociodemographic factors warrants continued investigation. Characterizing these relationships within Puerto Rico is critical to informing culturally and regionally tailored interventions, strengthening prenatal surveillance strategies, and ultimately reducing preventable maternal and neonatal morbidity.

This study is strengthened using standardized diagnostic criteria, detailed clinical data abstraction, and a focus on a high-risk population that remains underrepresented in the literature. Limitations include the retrospective design, which limits causal inference and may be subject to documentation bias. The single-center setting may limit generalizability, and residual confounding cannot be excluded.

In a high-risk obstetric population of patients living in Puerto Rico, hypertensive disorders of pregnancy were highly prevalent and strongly associated with maternal obesity and chronic hypertension. While associations with fetal growth restriction were not sustained after stratification, neonatal Apgar scores were lower among infants exposed to maternal hypertension. These findings emphasize the importance of population-specific research and targeted public health strategies to address cardiometabolic risk factors and improve maternal and neonatal outcomes in Puerto Rico.

Resumen

Objetivos: Caracterizar los perfiles clínicos de madres y neonatos en una población viviendo en Puerto Rico con trastornos hipertensivos del embarazo y evaluar su impacto en los resultados maternos y neonatales. **Métodos:** Se realizó un estudio retrospectivo de pacientes atendidas en la clínica de alto riesgo del Hospital Universitario de Distrito de Puerto Rico entre 2020 y 2023. Se excluyeron pacientes sin recién nacido vivo o con parto en otra institución. Los datos clínicos y demográficos se obtuvieron de expedientes médicos y se agruparon según estado hipertensivo. Se utilizaron estadísticas descriptivas para resumir antecedentes maternos, resultados del parto y datos neonatales. Las asociaciones se analizaron con pruebas de Chi-cuadrado, exacta de Fisher y Wilcoxon-Mann-Whitney, con significancia de $p \leq 0.05$. **Resultados:** De 278 madres, 40.3% ($n = 112$) presentó trastornos hipertensivos, incluyendo hipertensión crónica (40%) y preeclampsia (22%). Un mayor IMC materno se asoció significativamente con todos los trastornos hipertensivos. La hipertensión crónica se relacionó fuertemente con el desarrollo de preeclampsia, con 4.8 veces mayor probabilidad (IC 95%: 2.36–9.75). Estos trastornos se asociaron con menor edad gestacional al parto, pero no con mayor tasa de cesáreas. Los neonatos de madres afectadas presentaron puntuaciones de Apgar más bajas. **Conclusión:** Los trastornos hipertensivos fueron frecuentes y se asociaron con mayor IMC, mayor riesgo de preeclampsia en pacientes con hipertensión crónica, partos más tempranos y menor Apgar neonatal. Estos hallazgos resaltan la importancia de la detección temprana, manejo dirigido y fortalecimiento del cribado prenatal para reducir complicaciones en poblaciones de alto riesgo en Puerto Rico.

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