The impact of chronic hypertension and pregestational diabetes on pregnancy outcomes

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OBJECTIVE: The objective of the study was to examine the impact of chronic hypertension and pregestational diabetes on pregnancy outcomes.

STUDY DESIGN: This was a retrospective cohort study of 532,088 women undergoing singleton births in California in 2006. Women were categorized into chronic hypertension, pregestational diabetes, both, or neither. Pregnancy outcomes were compared using the χ^2 test and multivariable logistic regression to control for potential confounders.

RESULTS: We identified differences in perinatal outcomes between the groups. The rate of preterm birth in women with both conditions was 35.5% versus 25.5% in women with chronic hypertension versus 19.4% in women with pregestational diabetes ($P < .001$). The rate of small for gestational age was 18.2% in women with both versus 18.3% in women with chronic hypertension versus 9.7% in women with pregestational diabetes ($P < .001$).

CONCLUSION: The impact of having both chronic hypertension and pregestational diabetes in pregnancy varies, depending on the outcome examined. Although some had an additive effect (eg, stillbirth), others did not (eg, preeclampsia).

Key words: chronic hypertension, perinatal outcomes, pregestational diabetes

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Chronic hypertension in pregnancy is defined as elevated blood pressure that is present and documented before pregnancy. For women whose prepregnancy blood pressure is unknown, it is diagnosed by the presence of sustained hypertension before 20 weeks of gestation, defined as either a systolic blood pressure of at least 140 mm Hg or diastolic blood pressure of at least 90 mm Hg on at least 2 occasions separated by a minimum of 4-6 hours.[1]

Chronic hypertension complicates 1-5% of pregnancies in the United States and its prevalence varies, depending on the woman's age, race, and body mass index.[1,2] As the prevalence of advanced maternal age and obesity have increased among women of child-bearing age in the United States, so has the prevalence of chronic hypertension in pregnancy.[3-5] Pregnancies complicated by chronic hypertension are at increased risk for adverse neonatal and maternal outcomes including perinatal death, poor fetal growth, preterm birth, preeclampsia, and cesarean delivery.[1,5]

According to the Expert Committee on the Diagnosis and Classification of Diabetes, diabetes in pregnancy can be defined as pregestational (preexisting) diabetes or gestational diabetes. Most women with pregestational diabetes have type 1 or type 2 diabetes mellitus. An estimated 1.3% of pregnancies are complicated by pregestational diabetes mellitus, and this proportion is increasing with the rising prevalence of obesity and type 2 diabetes.[3,6] One study found between 1999 and 2005 that the prevalence of preexisting diabetes doubled for Hispanic women and white women, and nearly tripled for African American women.[6] Beyond maternal morbidity, pregestational diabetes is associated with fetal and neonatal death, congenital malformations, macrosomia, preterm delivery, preeclampsia, operative delivery, and maternal mortality.[7]

Beyond the association with pregnancy complications, what is the relationship between chronic hypertension and pregestational diabetes? One recent review reported the prevalence of chronic hypertension to be 2-11% in women with type 1 diabetes mellitus and 12-18% in women with type 2 diabetes mellitus.[8] The review found there were limited data looking at the combined effects of chronic hypertension and pregestational diabetes on pregnancy outcomes.[8] Because chronic hypertension and pregestational diabetes are 2 conditions that are independent risk factors for adverse pregnancy outcomes, the presence of both might be expected to have additive effects on obstetrical outcomes. Thus, the objective of our study was to compare maternal and neonatal outcomes in pregnant women with chronic hypertension, pregestational diabetes, or both.

Materials and Methods

We designed a retrospective cohort study of singleton births in women diagnosed with chronic hypertension, pre-

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TABLE 1
Demographic information among the 4 study groups

Characteristic	Control (n = 522,377)	Chronic HTN (n = 5560)	DM (n = 3718)	Both (n = 433)	*P* value[a]
Birthweight (mean g) (SD)	3340 (540)	3043 (788)	3429 (707)	3115 (915)	
Gestational age (mean wks) (SD)	38.7 (2.1)	37.5 (2.9)	38.0 (2.4)	37.0 (2.9)	
Maternal age, y					
Mean years (SD)	27.9 (6.3)	32.1 (6.1)	31.2 (6.2)	33.9 (5.9)	
Younger than 35	83.2%	62.3%	67.8%	50.2%	< .001
Older than 35	16.8%	37.7%	32.2%	49.9%	< .001
Parity					
Nulliparous	39.7%	34.3%	32.3%	32.7%	< .001
Multiparous	60.3%	65.8%	67.7%	67.4%	< .001
Race/ethnicity					
African American	5.0%	14.8%	5.9%	12.5%	< .001
Asian	11.5%	11.9%	10.9%	13.4%	< .001
White	33.6%	35.7%	26.6%	23.9%	< .001
Hispanic	47.2%	34.1%	53.7%	46.9%	< .001
Other	2.8%	3.6%	3.0%	3.2%	< .001
Education					
No college	54.3%	44.8%	57.2%	54.5%	< .001
Some college	45.7%	55.2%	42.8%	45.5%	< .001
Renal disease	0.1%	0.1%	0.3%	0.3%	< .05

Control included women without either chronic hypertension or pregestational diabetes. Some numbers do not add up to 100% due to rounding.
Both, patients with both chronic hypertension and pregestational diabetes; *DM,* pregestational diabetes; *HTN,* hypertension.

[a] χ^2.

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gestational diabetes, or both in California in 2006. Each of the 3 groups of women with chronic hypertension, diabetes, or both were compared with women who did not have either condition diagnosed.

The outcomes examined included gestational age at delivery, birthweight, intrauterine fetal demise (IUFD), preeclampsia, preterm birth (overall and <32 weeks), small for gestational age (SGA) defined as less than the 10th centile for gestational age, large for gestational age (LGA) defined as greater than the 90th centile for gestational age, shoulder dystocia, and placental abruption.[9,10] The data source was the California Vital Statistics Birth Certificate Data linked with the California Patient Discharge Data as well as Vital Statistics Death Certificate Data and Vital Statistics Fetal Death File in 2006.[11] The California Office of Statewide Health Planning and Development (OSHPD) Healthcare Information Resource Center under the State of California Health Human Services Agency performed the linkage of data.

Maternal antepartum and postpartum hospital records for the 9 months prior to delivery and 1 year after delivery, as well as birth records and all infant admission and readmissions occurring within the first year of life were included in the resultant linked datasets. Linkage for the mother/baby pair was achieved using the record linkage number, a unique alphanumeric encrypted code unique to the mother and the baby. Institutional review board approval was obtained from the Committee on Human Research at the University of California, San Francisco, the institutional review board at Oregon Health and Science University, and the California OSHPD and the Committee for the Protection of Human Subjects.

Women with a diagnosis of pregestational diabetes or chronic hypertension were identified using the *International Statistical Classification of Diseases and Related Health Problems, revision 9* (ICD-9) codes. ICD-9 codes used for the identification of women with pregestational diabetes included 648.0, 648.01, 648.02, 648.03, and 648.04. ICD-9 codes used for the identification of chronic hypertension included 642.0, 642.01, 642.02, 642.03, 642.04, 642.10, 642.11, 642.12, 642.13, 642.14, 642.20, 642.21, 642.22, 642.23, and 642.24. Exclusion criteria were multiple gestations and births with congenital anomalies.

Statistical calculations were performed with Stata (version 12; StataCorp, College Station, TX). Dichotomous outcomes were compared using a χ^2 test