MARYLAND PRAMS
Pregnancy Risk Assessment Monitoring System

Focus on Gestational Hypertension

Among Maryland Women Giving Birth 2001-2019

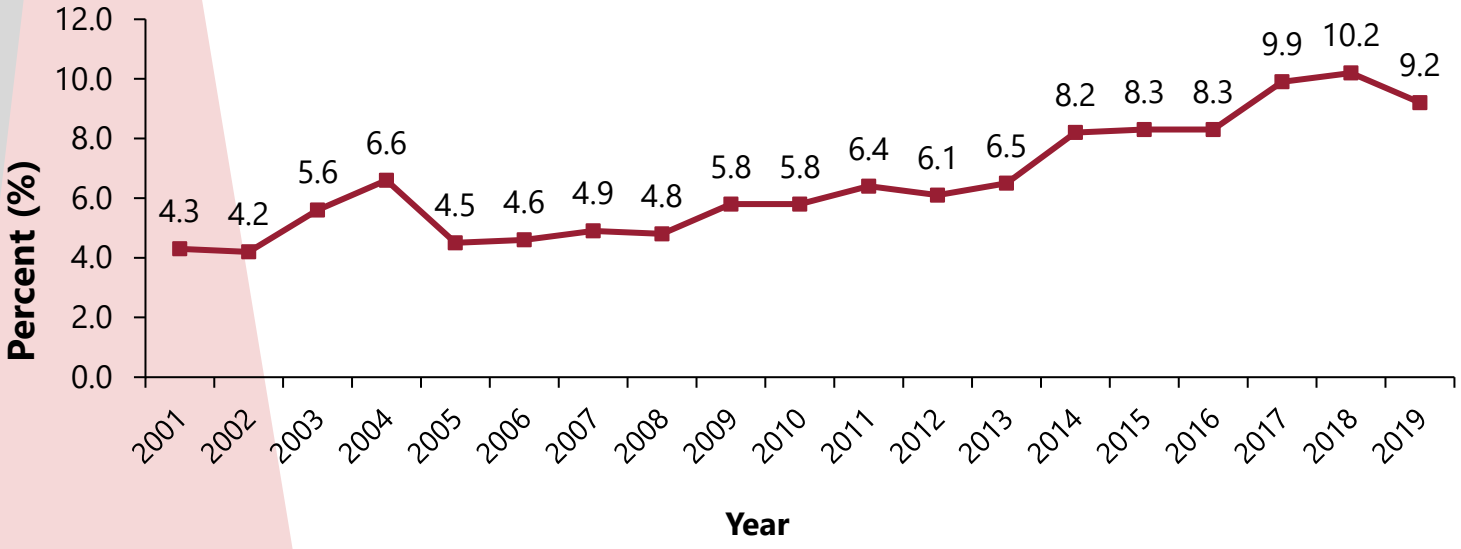
Introduction

In the United States, approximately six percent of all pregnant women experience gestational hypertension.[1] There are different types of hypertension conditions depending on when they occur in relation to pregnancy. Blood pressure readings more than 140/90 mmHg in pregnancy is considered abnormal and should be monitored closely.[2,3]

- **Chronic hypertension:** high blood pressure before pregnancy or before 20 weeks of pregnancy completion and/or high blood pressure that persists even 12 weeks postpartum
- **Gestational hypertension:** occurrence of high blood pressure after 20 weeks of pregnancy without excess protein in the urine.
- **Pre-eclampsia:** high blood pressure after 20 weeks of pregnancy accompanied by excess protein in the urine or other signs of maternal organ damage.
- **Superimposed preeclampsia:** worsening chronic hypertension during pregnancy accompanied by excess protein in the urine or other signs of maternal organ damage.

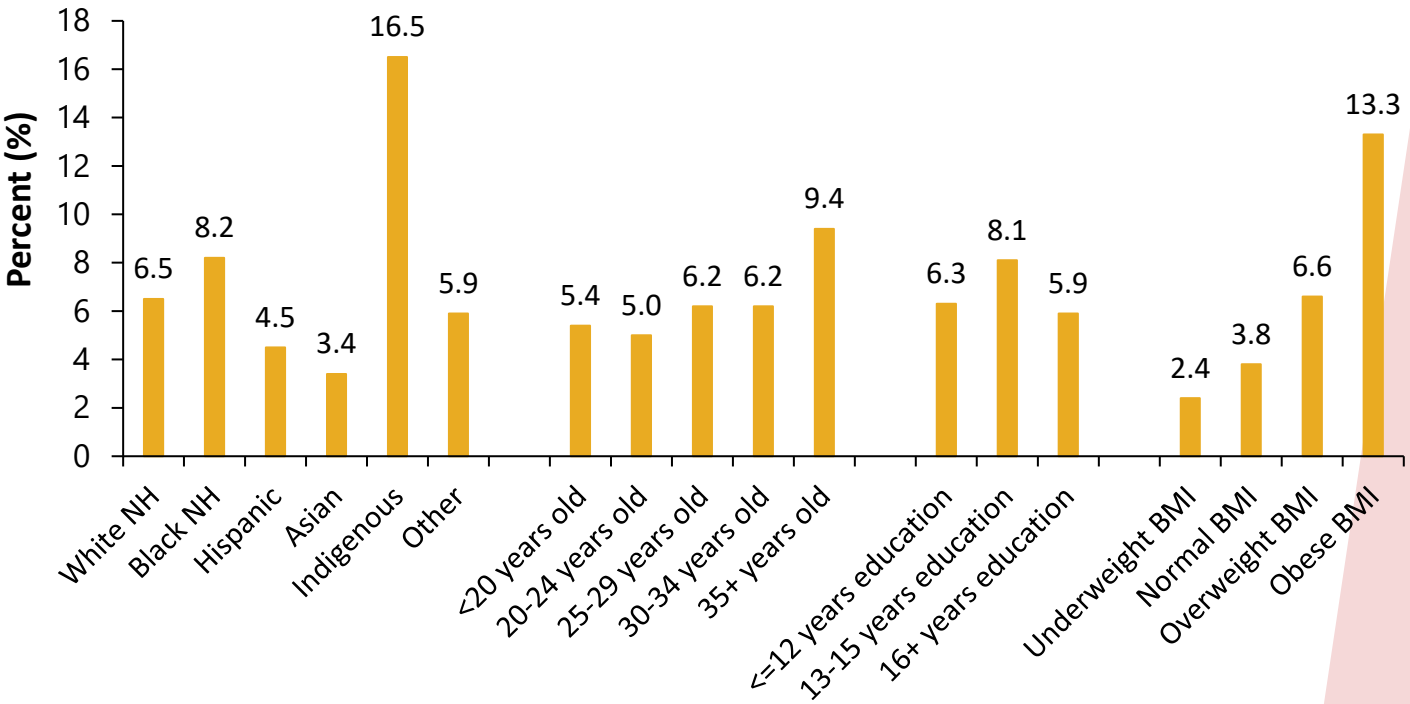
Hypertension during pregnancy is associated with adverse pregnancy outcomes including maternal stroke, seizure (eclampsia), heart or renal failure, placental abruption, fetal growth restriction and perinatal death. Preeclampsia is a common pregnancy complication, occurring in about every 1 of 25 pregnancies in the United States.[4] Preeclampsia can be serious and even fatal. The most effective treatment for preeclampsia is delivery of the baby. In earlier stages of pregnancy, doctors may suggest bed rest, hospitalization or medication.

Figure 1: Prevalence of Gestational Hypertension by Year, Maryland, 2001-2016



In rare cases women, including those who did not have high blood pressure during pregnancy, develop postpartum preeclampsia.[4] Although postpartum preeclampsia does not directly impact the infant, the mothers are still at risk for complications of the condition including stroke, pulmonary edema (life-threatening condition when excess fluid develops in the lungs), thromboembolism (the blockage of a blood vessel by a blood clot), cardiomyopathy, and other severe illnesses.

Figure 2: Weighted Prevalence of Gestational Hypertension by Demographic Characteristics, Maryland, 2001-2019



Demographics

Among Maryland mothers who delivered from 2001–2019, 6.5 percent experienced either chronic or pregnancy induced-hypertension. The prevalence of gestational hypertension has increased over the past nineteen years, with the highest prevalence occurring in 2018 (10.2 percent), and the lowest occurring in 2002 (4.2 percent) (Figure 1).

Figure 2 displays the prevalence of gestational hypertension by demographic variables . Indigenous women (Odds Ratio [OR] 2.8, 95% Confidence Interval [CI] 0.8-9.6) and Black Non-Hispanic women (OR 1.3, CI 1.1-1.5) had significantly higher odds of being hypertensive during pregnancy compared to White Non-Hispanic women. The results of the analysis also indicate that Asian Non-Hispanic women (OR 0.5, CI 0.4- 0.7) experience significantly lower odds of gestational hypertension when compared to the reference group of White Non-Hispanic women.

In general, the prevalence of hypertension increases with age.[6] In this sample of Maryland women, mothers between 20 and 24 years (OR 0.8, CI 0.6-1.0) had significantly lower odds of gestational hypertension when compared with the reference group of mothers that were between 25-29 years of age. However, women 35 years of age or older had significantly higher odds (OR 1.6, CI 1.3-1.9) of having gestational hypertension when compared to the reference group.

There were also significant differences in the likelihood of having gestational hypertension when examined by years of formal education. It was expected that this could be due to the age differences between women with more and less formal education. In the analysis that controlled for age as a potential confounder, Maryland mothers with 13 to 15 years of formal education had significantly higher odds (Adjusted Odds Ratio [AOR] 1.2, CI 1.0-1.4) of gestational hypertension when compared to mothers in the sample with 12 or fewer years of age. However, women with 16 or more years of education had significantly lower odds (AOR 0.8, CI 0.6- 0.9) of gestational hypertension.

One of the most common predictors of hypertension is maternal weight. The results from this sample clearly illustrate the association between body mass index (BMI) and gestational hypertension. Mothers who were underweight had significantly lower odds of gestational hypertension (OR 0.6, CI: 0.4-1.0). Conversely, mothers who were overweight (OR 1.8, CI 1.5-2.1) or obese (OR 3.9, CI 3.4-4.5) experienced significantly greater odds of gestational hypertension.
Insurance type, WIC utilization, and having low income were all examined as proxy for socioeconomic status. None of those variables were significantly associated with gestational hypertension.

Table 1: Prenatal Protective and Risk Factors for Gestational Hypertension, Maryland, 2001-2019

	Gestational Hypertension		Adjusted Odds Ratio	
	%	(95% CI)	AOR	(95% CI)
Total	**6.5**	**(6.2 – 6.9)**		
Multivitamin use 1 month prior to pregnancy				
No multivitamin use	6.7	(6.2 – 7.3)	**REF**	
1-3 times/week	5.1	(4.0 – 6.2)	0.8	(0.6 – 1.0)
4-6 times/week	6.8	(5.3 – 8.3)	1.0	(0.8 – 1.3)
Every day/week	6.6	(5.9 – 7.2)	1.0	(0.9 – 1.1)
Prenatal care initiation				
1st trimester	6.6	(6.2 – 7.0)	**REF**	
2nd or 3rd trimester	6.0	(5.1 – 6.9)	0.9	(0.8 – 1.1)
No prenatal care	7.6	(3.4 – 11.9)	1.2	(0.7 – 2.3)
Smoked tobacco during pregnancy	7.7	(6.1 – 9.2)	1.1	(0.8 – 1.5)
Consumed alcohol during pregnancy	6.2	(4.8 – 7.5)	1.0	(0.8 – 1.2)
Binged alcohol during pregnancy	6.6	(1.2 – 12.1)	1.1	(0.5 – 2.7)
Worked during pregnancy (2012-2019)	8.3	(7.5 – 9.2)	0.8	(0.6 – 1.0)

Prenatal Factors

Behaviors during pregnancy have potential to either protect against disease or increase risk for disease. The following table illustrates how protective factors (multivitamin consumption and prenatal care) and risk factors (alcohol and tobacco use) impact gestational hypertension. Working during pregnancy was also evaluated, because of the physical and mental stress that it may cause the mother.

When controlling for race, ethnicity, age, education, and BMI, the following risk factors were not significantly associated with gestational hypertension: frequency of multivitamin use, initiation of prenatal care, smoking during pregnancy, drinking during pregnancy, and working during pregnancy.

Stress

Stress is one of the most studied causes of chronic and gestational hypertension. Furthermore, mothers may turn to unhealthy coping mechanisms, such as cigarette use or alcohol use, in efforts to manage stress.

Table 2: Stress Factors and Gestational Hypertension, Maryland, 2001-2015

	Gestational Hypertension		Adjusted Odds Ratio	
	%	(95% CI)	AOR	(95% CI)
Total	**6.5**	**(6.2 – 6.9)**		
Number of Stress Factors				
No stressors	4.8	(4.1 – 5.4)	**REF**	
1-2 stressors	5.9	(5.3 – 6.6)	1.2	(1.0 – 1.5)
3+ stressors	6.6	(5.8 – 7.4)	1.3	(1.0 – 1.6)
Stress Inducing Factors				
Family member ill*	7.2	(6.3 – 8.1)	1.2	(1.0 – 1.5)
Divorce	5.8	(4.3 – 7.2)	0.9	(0.7 – 1.2)
Moved	6.0	(5.3 – 6.7)	1.2	(1.0 – 1.4)
Homeless	5.7	(3.4 – 8.0)	1.1	(0.7 – 1.7)
Husband/partner lost job	5.5	(4.4 – 6.7)	0.9	(0.7 – 1.2)
Mom lost job	6.0	(4.7 – 7.2)	1.0	(0.8 – 1.2)
Argued with husband/partner more than usual	6.7	(5.8 – 7.6)	1.2	(1.0 – 1.4)
Husband/partner did not want me to be pregnant	6.3	(4.8 – 7.7)	1.0	(0.8 – 1.3)
Difficulty paying rent, mortgage, or other bills	6.5	(5.6 – 7.4)	1.0	(0.8 – 1.2)
Husband/partner or I went to jail	7.1	(4.4 – 9.7)	1.1	(0.7 – 1.8)
Someone very close to me used drugs*	7.3	(5.9 – 8.8)	1.2	(1.0 – 1.6)
Someone very close to me died	6.4	(5.4 – 7.5)	1.0	(0.9 – 1.3)

*Statistical significance between groups.

Respondents were asked to indicate all the stressors that they experienced in the 12 months before completing the questionnaire. The following table displays how the number of stress factors and each of the individual stress factors is associated with gestational hypertension. The prevalence describes the percent of the population with gestational hypertension that experienced each type of stress. The adjusted odds ratio (AOR) displays the odds of gestational hypertension and the given stress factor compared to those who experienced gestational hypertension without the given stress factor. This analysis controls for race/ethnicity, age, education, and body mass index to minimize the chance of confounding.

Stress caused by a family member being very ill and hospitalized within 12 months before delivery was the only statistically significant stress factor. Mothers who reported stress from a family member being very ill and hospitalized were 1.2 times more likely to have gestational hypertension compared to mothers who did not report stress factors.

Infant Outcomes

Table 3 details infant birth outcomes among mothers with gestational hypertension. The binary infant outcomes display the prevalence of gestational hypertension among Maryland women and the associated infant outcome. The adjusted odds ratio displays the odds of having gestational hypertension and giving birth to an infant with the indicated outcome compared to having gestational hypertension and giving birth to an infant without the indicated outcome.

There were statistically significant differences in the odds of mothers with gestational hypertension giving birth to infants with the indicated outcomes compared to giving birth to infants without the indicated outcomes. Mothers with gestational hypertension had 3.5 times the odds of giving birth to infants that were low birth weight compared to giving birth to infants with a normal birth weight. Mothers with gestational hypertension also had 2.4 times the odds of giving birth to infants that stayed in the neonatal intensive care unit (NICU) compared to delivering an infant who did not stay in the NICU.

Mothers who had gestational hypertension were less likely (AOR:0.6, CI 0.4-1.0) to deliver an infant with a greater gestational age (late term, 41 weeks old) compared to delivering an infant in the normal gestational age range. While mothers who had gestational hypertension were more likely to deliver infants that were extremely preterm (AOR:2.5, CI 2.0-3.1), very preterm (AOR: 5.2, CI 4.3-6.2), late preterm (AOR:4.9, CI 4.2-5.7) and early term (AOR:2.6, CI 2.2-3.0) compared to delivering an infant of normal gestational age.

In the sample of respondents, Maryland mothers who had gestational hypertension were significantly less likely to deliver an infant with a higher birth weight than an infant with a normal birth weight (AOR:0.6, CI 0.4-0.8). Mothers who had gestational hypertension were more likely to deliver infants that were extremely low birth weight (AOR:2.5, CI 2.1-3.0), very low birth weight (AOR: 5.1, CI 4.3-6.0), and moderately low birth weight (AOR:3.3 CI 3.0-3.6) compared to delivering an infant of with a normal birth weight. Maryland mothers with gestational hypertension had significantly higher odds of delivering an infant with a longer hospital stay after birth. Mothers with gestational hypertension had 3.8 times (CI 3.2-4.5) the odds of delivering an infant with a hospital stay of six days or longer, and significantly higher odds of their infant still being in the hospital at the time that they responded to the survey (AOR: 2.9, CI 2.1-4.1) compared to the reference group of infants with a hospital stay of one to two days.

Table 3: Infant Birth Outcomes Among Mothers With Gestational Hypertension, Maryland, 2001-2019

	Gestational Hypertension		Adjusted Odds Ratio	
	%	(95% CI)	AOR	(95% CI)
Total	**6.5**	**(6.2 – 6.9)**		
Binary Infant Outcomes				
Preterm Birth*	17.0	15.7-18.3	3.4	3.0-3.8
Low Birth Weight*	17.3	16.6-17.9	3.5	3.2-3.9
Infant admitted to NICU* (2001-2015)	11.9	10.7-13.1	2.4	2.1-2.8
Small for gestational age *	12.4	10.7-14.1	2.3	2.0-2.8
Birth Defects	7.1	3.4-10.9	1.1	0.7-1.9
Gestational Age				
Extremely preterm (<28 weeks)*	10.7	9.0-12.5	2.5	2.0-3.1
Very preterm (28-31 weeks)*	18.7	16.6-20.7	5.2	4.3-6.2
Late preterm (32-36 weeks)*	17.4	15.8-19.0	4.9	4.2-5.7
Early term (37-38 weeks)*	9.7	8.8-10.7	2.6	2.2-3.0
Full term (39-40 weeks)	4.0	3.6-4.4	**REF**	
Late term (41 weeks)*	2.5	1.6-3.5	0.6	0.4-1.0
Birth Weight				
Extremely low (<1000 grams)*	15.2	13.2-17.2	2.5	2.1-3.0
Very low (1000-1499 grams)*	24.6	22.2-27.1	5.1	4.3- 6.0
Moderately low (1500-2499 grams)*	16.7	15.9-17.4	3.3	3.0-3.6
Normal (2500-3999 grams)	5.8	5.3-6.2	**REF**	
High (4000+ grams)*	4.2	3.0-5.4	0.6	0.4-0.8
Days Spent in Hospital After Birth				
<1 day	4.2	1.8-6.6	0.9	0.5-1.8
1-2 days	4.3	3.9-4.8	**REF**	
3-5 days	8.1	7.3-8.8	1.7	1.5-2.0
6+ days*	16.2	14.7-17.7	3.8	3.2-4.5
Currently remains in hospital*	14.3	10.7-6.1	2.9	2.1-4.1

*Statistical significance between groups.

Conclusions

The prevalence of gestational hypertension among Maryland mothers between 2001-2019 of 6.5 percent aligns with the national prevalence at approximately six percent. In this sample, Indigenous women were three times more likely to experience gestational hypertension compared to their white non-Hispanic counterparts. Black Non-Hispanic women were also more likely to experience gestational hypertension compared to their white non-Hispanic counterparts. Gestational hypertension and pre-eclampsia are more likely to occur in people over the age of 40 and those who are above the normal body mass index range.[4] In this sample of Maryland mothers who gave birth between 2001 and 2019, mothers who were obese experienced over three times the prevalence rate of gestational hypertension than those who were in the normal weight range.

Maryland mothers with gestational hypertension were more likely to deliver an infant that would be born preterm, have low birth weight, stay in the NICU or be small for gestational age compared to delivering infants without those outcomes. Maryland mothers with gestational hypertension had nearly five times the odds of delivering a late preterm infant compared to an infant of normal gestational age. They also had over five times the odds of delivering an infant with a very low birth weight compared to an infant with a normal birth weight.

PRAMS Methodology

Data included in this report were collected through the Pregnancy Risk Assessment Monitoring System (PRAMS), a surveillance system established by the Centers for Disease Control and Prevention (CDC) to obtain information about maternal behaviors and experiences that may be associated with adverse pregnancy outcomes.

Each month, a sample of approximately 200 Maryland women who have recently delivered live born infants are surveyed by mail or by telephone, and responses are weighted to make the results representative of all Maryland births. This report is based on the responses of 26,253 Maryland mothers who delivered live infants between January 1, 2001 and December 31, 2019 and were surveyed two to nine months after delivery.

Data regarding gestational hypertension was primarily analyzed using birth certificate data, which is linked to survey responses. Birth certificate data was used to determine if a respondent had hypertension as opposed to survey responses because medical documentation decreases the likelihood of recall bias impacting the analysis. Birth certificate data was also consistently collected across all nineteen years unlike the PRAMS survey questions which changed sightly between phases.

Limitations

Although estimates for the associations between obesity and the outcomes are adjusted for demographics, it is possible that characteristics not collected by the survey may explain some of the associations seen in this report.

References

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3. Of note, in 2017, the definition of high blood pressure in nonpregnant adults was revised by the American College of Cardiology and the American Heart Association. Stage 1 Hypertension includes a systolic 130-139 mm Hg or diastolic 80 to 89 mm Hg. Stage 2 is a systolic blood pressure of at least 140 mm Hg or diastolic at least 90 mm Hg. For further information please visit the Clinical Practice Guidelines here: https://www.jacc.org/doi/abs/10.1016/j.jacc.2017.11.006
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