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Characterizing Hypertensive Disorders of Pregnancy Among Medicaid Recipients in a Nonexpansion State

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Abstract

Background: The incidence of hypertensive disorders of pregnancy (HDP) are on the rise in the United States, especially in the South, which has a heavy chronic disease burden and large number of Medicaid nonexpansion states. Sizeable disparities in HDP outcomes exist by race/ethnicity, geography, and health insurance coverage. Our objective is to explore HDP in the Alabama Medicaid maternity population, and the association of maternal sociodemographic, clinical, and care utilization characteristics with HDP diagnosis.
Materials and Methods: Data were from Alabama Medicaid delivery claims in 2017. Bivariate analyses were used to examine maternal characteristics by HDP diagnosis. Hierarchical generalized linear models, with observations nested at the county level, were used to assess multivariable relationships between maternal characteristics and HDP diagnosis.
Results: Among women with HDP diagnosis, a higher proportion were older, Black, had other comorbidities, and had more perinatal hospitalizations or emergency visits compared with those without HDP diagnosis. There were increased odds of an HDP diagnosis for older women and those with comorbidities. Black women (adjusted odds ratio [aOR] = 1.24, 95% confidence interval [CI]: 1.16–1.33), women insured only during pregnancy by Sixth Omnibus Reconciliation Act Medicaid (aOR = 1.08, 95% CI: 1.02–1.15), and women entering prenatal care (PNC) in the second trimester (aOR = 1.10, 95% CI: 1.03–1.18) had elevated odds of HDP diagnosis compared with their counterparts.
Conclusions: Beyond traditional demographic and clinical risk factors, not having preconception insurance coverage or first trimester PNC entry were associated with higher odds of HDP diagnosis. *Improving the provision and timing of maternity coverage* among Medicaid recipients, particularly in nonexpansion states, may help identify and treat women at risk of HDP and associated adverse perinatal outcomes.

Keywords: preconception insurance, hypertension, maternal health, Medicaid, health disparities

Introduction

Although the rate of hypertensive disorders in the United States (U.S.) has remained relatively constant in recent years affecting one in three Americans, the prevalence of hypertensive disorders of pregnancy (HDP) has increased.[1,2] HDP is any hypertensive condition occurring during or as a result of pregnancy (chronic and gestational hypertension, preeclampsia, and eclampsia) affecting 6.9% of pregnancies in the U.S.[3] HDP burdens the U.S. health care system financially, with costs related to preeclampsia alone exceeding $2 billion annually.[4] Impaired fetal development is of concern among women with HDP, including fetal growth restriction, low birth weight, and preterm birth.[5,6] However, HDP is also associated with adverse maternal health conditions during pregnancy, including placental

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abruption and postpartum hemorrhage, as well as risk of disease later in life, including fatal cardiovascular disease, ophthalmic complications, and impaired cognition.[5,7–10] HDP is strongly associated with life-threatening severe maternal morbidities (SMM) and maternal mortality, both of which have been increasing in recent years in the U.S.[6,11–13]

As with other health outcomes, there are disparate burdens of HDP with differences by sociodemographic and care utilization characteristics. The highest rates of HDP occur among Black women, whose risk of maternal mortality is almost three times higher compared with White women.[14,15] Postpartum follow-up of women with HDP, a vital strategy to mitigate future disease risk and prevent sequelae, is also lower among Black women compared with White women.[16] Additionally, the prevalence of HDP is highest in the South (8.9%) compared with other regions in the U.S.[3] Adverse socioeconomic environment, higher prevalence of chronic health conditions, and racial and ethnic disparities have been identified as several socioecological factors contributing to higher rates of HDP in the South.[3,17] For example, postpartum readmissions, including many related to HDP, are highest in the South even after controlling for comorbidities, demographic characteristics, and hospital factors.[18,19]

Lastly, women insured by Medicaid have higher recorded blood pressures,[20] increased risk of early onset HDP,[21] and more postpartum emergency room visits[22] than women with private insurance. Although it is well established that there are variations in chronic hypertension in the South among certain populations, especially minorities and those with less access to care,[23,24] the nature of differences in HDP among women in the South is largely unknown. This is especially relevant considering that half of nonexpansion states—those which have not adopted wider Medicaid income eligibility subsidized under the Affordable Care Act—are located in the South.[25]

The objective of this study was to explore how maternal sociodemographic, clinical, and care utilization characteristics are related to HDP diagnosis in the South. Specifically, we examined these characteristics among women whose deliveries were covered by Medicaid in Alabama, a nonexpansion state. We hypothesized that differences in maternal characteristics exist between women diagnosed with any HDP compared with those without an HDP diagnosis.

Materials and Methods

We conducted a retrospective study using data from Alabama Medicaid administrative claims. Observations for these analyses were restricted to Medicaid recipients with a delivery claim in the calendar year 2017, before the substantial reorganization of Alabama Medicaid's case management services. To capture data from the preconception, prenatal, and postpartum periods for each observation, all claims were gathered for 12 months before and 60 days after the date of delivery. HDP was defined as any HDP diagnosis claim during the observation period using International Classification of Diseases (ICD), Ninth and Tenth Revisions, Clinical Modification (CM) codes encompassing any hypertensive condition during pregnancy (ICD-9-CM: "642" and ICD-10-CM: "O10, O11, O12, O13, O14, O15, and O16"). Both ICD-9 and ICD-10 codes were used to account for claims affected by the transition between the Ninth and Tenth revisions.

Maternal characteristics encompassed sociodemographic, clinical, and care utilization characteristics. Sociodemographic characteristics included maternal race, ethnicity, age, Medicaid eligibility type, proportion of county-level Medicaid enrollment, and county rurality. Race/ethnicity (Black [non-Hispanic], White [non-Hispanic], Hispanic, or other race/ethnicity [non-Hispanic]), and age (<19, 19–24, 25–29, 30–34, and >34) were captured directly from Medicaid claims.

Eligibility type—captured from the first observed claim during pregnancy—was divided into five groups based on maternity eligibility categories in Alabama: (1) Medicaid for low-income families (MLIF; household income below 18% of the federal poverty level [FPL] for parents and caretakers only); (2) Sixth Omnibus Reconciliation Act (SOBRA; household income below 146% FPL if pregnant); (3) Child Health Insurance Program (CHIP; household income below 317% FPL if <19 years of age); (4) disability (Supplemental Security Income or state disability), or (5) Noncitizen (women without citizenship but whose unborn child would qualify for Medicaid after birth; eligible for coverage of labor and delivery services only).

Women eligible for SOBRA are not eligible for preconception Medicaid coverage unlike women eligible for MLIF, CHIP, and Disability. Because the prevalence of hypertension can vary widely by county, county-level variables were also considered.[26] Poverty was estimated using maternal county Medicaid enrollment and categorized as low (<25%), medium (25%–29%), and high (>29%) based on the proportion of county residents enrolled in Medicaid for at least 1 month during the calendar year.[27] Maternal county rurality was defined as urban, moderately rural, or rural according to the classification developed by the Alabama Rural Health Association.[28]

Maternal clinical characteristics included obesity, preexisting diabetes, gestational diabetes, any mental health condition, smoking use, substance use, Cesarean delivery, preterm birth, and SMM. These conditions and procedures were captured using relevant ICD-9-CM and ICD-10-CM codes directly from the claims data. SMM was defined as a composite variable using codes for 16 of the 21 outcomes designated by the Centers for Disease Control and Prevention (CDC) as SMM.[29] Aneurysm, anesthesia complications, transfusion, tracheostomy, and ventilation were excluded due to data unavailability. Eclampsia was included in the composite HDP variable and SMM variable to account for women who developed eclampsia but had an undiagnosed HDP before.

Maternal care utilization characteristics included trimester of prenatal care (PNC) entry, type of prenatal and delivery provider, prenatal and postpartum hospitalizations, and emergency visits (coded separately from routine prenatal care). PNC entry date was defined as the date of first claim occurring later than 275 days before delivery, an estimate of the average gestational period. The difference in days between PNC entry date and delivery date was converted into weeks and categorized by trimester. For observations with a preterm birth claim, the delivery date was adjusted to account for shorter gestation in the calculation for PNC entry trimester. Prenatal and delivery provider types were captured directly from Medicaid claims, although more than 15% of observations were missing data for prenatal provider. Inpatient hospital claims, excluding delivery hospitalization, were captured and divided into prenatal and postpartum hospitalizations based on the date of delivery. Claims for emergency visits occurring at any point in the observation period were captured through related hospital claims.

Descriptive statistics were calculated for the study sample, then chi square and Cramer's *V* statistics were computed to assess differences in variable distributions by HDP diagnosis. All cases meeting inclusion criteria were considered in descriptive statistics, but observations with missing data were not counted in the frequencies and proportions for the variables for which data were missing. Hierarchical generalized linear models, or mixed models, were then used to assess multivariable relationships with HDP diagnosis as the outcome variable. Mixed models are helpful when data are suspected to be nested because ignoring nesting can impact the power to detect treatment and covariate effects, inflating Type I error rates.[30,31]

Because the prevalence of hypertension can vary widely by county, observations were nested at the maternal residence county level in these analyses.[26] A random intercept only model was first estimated to model random effects by maternal residence county, and the intraclass correlation coefficient (ICC) was computed to estimate the total variation in the outcome accounted for by county differences.[32] Models were specified using a binary distribution and logit link, and Wald *Z* tests were used to determine whether statistical variability in the outcome was present between counties in the sample.[30]

Mixed models were then built iteratively adding additional levels of variables (sociodemographic, clinical, and care utilization variables) to the intercept only model until the most parsimonious model was produced. Nested level effects (*i.e.,* county variables) were included lastly to examine additional county variation beyond that estimated by random intercepts, and Laplace estimation was used to enable comparison of model fit using −2 log likelihood values.[30] Maternal characteristics were considered as covariates based on prior literature and bivariate analysis, and collinearity tests were conducted to ensure independent variables were not correlated. The iterative selection of variables was driven by findings from similar studies, which indicated varying effects on obstetric outcomes from differing socioecological levels.[33,34]

Because noncitizen recipients were only eligible for labor and delivery services, data were not available to assess HDP diagnosis during pregnancy, and these individuals were therefore not included in mixed models. Odds ratios (OR) and 95% confidence intervals (CIs) were calculated for each characteristic in the model using specified reference groups. All analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, NC). This study was approved by the University of Alabama at Birmingham Institutional Review Board.

Results

There were 32,761 Medicaid delivery claims in 2017. Of the total, 20.9% also had an HDP diagnosis claim. Sociodemographic characteristics differed for women with an HDP diagnosis compared with those without an HDP diagnosis (Table 1). Those with HDP diagnosis were more likely to be older, Black, and live in a county with medium Medicaid enrollment. Also, compared with those without HDP diagnosis, proportions of clinical comorbidities were higher among women with HDP diagnosis for all conditions examined. Almost half of women with an HDP diagnosis had a cesarean delivery (46.5%) as well as higher rates of preterm birth (12.0%) and SMM (8.7%). When examining care utilization characteristics, no differences by HDP diagnosis existed across provider type, but women with an HDP diagnosis were more likely to initiate PNC in the first trimester or have a perinatal hospitalization or emergency department visit compared with women without an HDP diagnosis.

Results from mixed models are presented in Table 2. Significant variability ($p < 0.0001$) in HDP diagnosis was present at the county level across models, but only 2% of variability in HDP diagnosis was explained by county-level differences (ICC = 0.019). Model 3 represents the best-fitting model indicated by the significantly lowest −2 log likelihood value. For sociodemographic characteristics, women over age 34 (adjusted OR [aOR] = 2.02, 95% CI: 1.80–2.25) had two-times higher odds of HDP diagnosis compared with women ages 19–24. Black women had higher odds of HDP diagnosis (aOR = 1.24, 95% CI: 1.16–1.33), whereas Hispanic women had lower odds (aOR = 0.55, 95% CI: 0.44–0.68) compared with White women. Elevated odds of HDP diagnosis were seen by eligibility type among women in the SOBRA (aOR = 1.08, 95% CI: 1.02–1.15) and Disability categories (aOR = 1.28, 95% CI: 1.12–1.46) compared with women in the MLIF category.

Among the clinical or comorbid conditions, women with documented obesity (aOR = 2.99, 95% CI: 2.79–3.22) and preexisting diabetes (aOR = 2.26, 95% CI: 1.90–2.67) had substantially higher odds of having an HDP diagnosis compared with those without these conditions. For care utilization characteristics, PNC entry in the second trimester, after controlling for other factors, was associated with elevated odds of HDP diagnosis (aOR = 1.10, 95% CI: 1.03–1.18), whereas having no PNC was associated with lower odds of HDP diagnosis (aOR = 0.72, 95% CI: 0.55–0.95) compared with women entering PNC in the first trimester.

Discussion

This study utilized Alabama Medicaid administrative claims to explore sociodemographic, clinical, and care utilization characteristics associated with the diagnosis of HDP. Consistent with previous literature, Black race, increased maternal age, and presence of comorbidities were associated with higher odds of having an HDP diagnosis.[3] In our study, there was significant variation by county, but this explained only a small proportion of variability in HDP diagnosis. After multivariable analyses, women who entered PNC in the second trimester had higher odds of HDP diagnosis compared with those with first trimester PNC entry. Similarly, those eligible for SOBRA Medicaid (*i.e.,* without preconception insurance coverage) had higher odds of HDP diagnosis compared with those eligible for MLIF (*i.e.,* with preconception coverage). Therefore, this suggests that women covered by Medicaid who encounter the medical system either before or earlier in pregnancy are less likely to have a diagnosed HDP during pregnancy.

There are a number of possible explanations for our findings. There may be unmeasured differences between the population that enters into the system of care before or early in pregnancy and the population that does not. It is also possible that women covered by Medicaid during the preconception period or who enter PNC in the first trimester

Table 1. Descriptive Characteristics of the Alabama Medicaid Maternity Population by Hypertensive Disorder of Pregnancy Diagnosis Claim, 2017

	Total population		*Without HDP*		*With HDP*[a]			
	n *32,761*	% *100.0*	n *25,904*	% *79.1*	n *6,857*	% *20.9*	p	*Cramer's* V
Sociodemographic								
Age							<0.0001	0.0949
<19	2,076	6.3	1,726	6.7	350	5.1		
19–24	13,835	42.2	11,291	43.6	2,544	37.1		
25–29	9,641	29.4	7,642	29.5	1,999	29.2		
30–34	4,835	14.8	3,628	14.0	1,207	17.6		
>34	2,374	7.3	1,617	6.2	757	11.0		
Race/ethnicity[b]							<0.0001	0.1099
Black	13,497	41.2	10,110	39.0	3,387	49.4		
Hispanic	2,723	8.3	2,449	9.5	274	4.0		
Other	2,751	8.4	2,333	9.0	418	6.1		
White	13,790	42.1	11,012	42.5	2,778	40.5		
Eligibility type[c]							<0.0001	0.1031
CHIP	1,114	3.4	905	3.5	209	3.1		
MLIF	11,647	35.6	9,097	35.1	2,550	37.2		
Disability	1,378	4.2	948	3.7	430	6.3		
SOBRA	15,792	48.2	12,377	47.8	3,415	49.8		
Noncitizen	2,830	8.6	2,577	10.0	253	3.7		
County rurality[d]							0.1160	0.0115
Urban	18,369	56.1	14,491	55.9	3,878	56.6		
Moderately rural	5,818	17.8	4,570	17.6	1,248	18.2		
Rural	8,572	26.2	6,843	26.4	1,729	25.2		
County Medicaid enrollment[e]							<0.0001	0.0444
Low	9,720	29.7	7,918	30.6	1,802	26.3		
Medium	11,734	35.8	9,033	34.9	2,701	39.4		
High	11,305	34.5	8,953	34.6	2,352	34.3		
Clinical[f]								
Obesity	4,600	14.0	2,613	10.1	1,987	29.0	<0.0001	0.2212
Preexisting diabetes	775	2.4	369	1.4	406	5.9	<0.0001	0.1204
Gestational diabetes	2,667	8.1	1,674	6.5	993	14.5	<0.0001	0.1193
Any mental health condition	7,537	23.0	5,534	21.4	2,003	29.2	<0.0001	0.0759
Smoking use	6,298	19.2	4,798	18.5	1,500	21.9	<0.0001	0.0346
Substance use	2,463	7.5	1,896	7.3	567	8.3	0.008	0.0147
Cesarean delivery	11,151	34.0	7,961	30.7	3,190	46.5	<0.0001	0.1355
Preterm birth	2,929	8.9	2,107	8.1	822	12.0	<0.0001	0.0549
Severe maternal morbidity	1,289	3.9	694	2.7	595	8.7	<0.0001	0.1255
Care utilization								
Prenatal care provider[g]							0.4646	0.0075
OBGYN	24,677	91.7	19,407	91.7	5,270	91.6		
Family medicine	1,082	4.0	861	4.1	221	3.8		
Other	1,153	4.3	893	4.2	260	4.5		
Delivery provider							0.5820	0.0057
OBGYN	29,904	91.3	23,648	91.3	6,256	91.2		
Family medicine	1,401	4.3	1,117	4.3	284	4.1		
Other	1,452	4.4	1,135	4.4	317	4.6		
Trimester PNC entry[h]							<0.0001	0.0686
First	21,398	65.3	16,693	64.5	4,705	68.6		
Second	7,399	22.6	5,819	22.5	1,580	23.0		
Third	2,619	8.0	2,166	8.4	453	6.6		
None	1,341	4.1	1,222	4.7	119	1.7		

(*continued*)

Table 1. (Continued)

	Total population		Without HDP		With HDP[a]			
	n 32,761	% 100.0	n 25,904	% 79.1	n 6,857	% 20.9	p	Cramer's V
Hospitalizations[i]								
Prenatal	7,731	23.6	5,687	22.0	2,044	29.9	<0.0001	0.0757
Postpartum	2,458	7.5	1,629	6.3	829	12.1	<0.0001	0.0899
Emergency department visit[j]	14,275	43.6	10,706	41.3	3,569	52.1	<0.0001	0.0879

Source: Alabama Medicaid administrative claims, 2017.

Missing data for prenatal care provider >15%; *p*-values from chi-square significance tests and Cramer's *V* statistics compare distribution between women with and without HDP diagnosis.

[a]Hypertensive disorders of pregnancy; includes observations with any of the following diagnosis codes: ICD-9-CM: ''642'' and ICD-10-CM: ''O10, O11, O12, O13, O14, O15, and O16.''

[b]Non-Hispanic unless otherwise noted.

[c]CHIP: household income below 317% FPL if <19 years of age; MLIF: household income below 18% FPL for parents and caretakers only; SOBRA: household income below 146% FPL if pregnant; disability: encompasses individuals on Supplemental Security Income or disability or other unspecified category; noncitizen: women without citizenship but whose unborn child would qualify for Medicaid after birth.

[d]As defined by methodology developed by the Alabama Rural Health Association.

[e]Low (<25%), medium (25%–29%), and high (>29%) based on proportion of county residents insured by Medicaid for at least 1 month during 2017.

[f]Captured using corresponding ICD-9 and ICD-10-CM diagnosis and procedure codes.

[g]Missing data for prenatal care provider >15%.

[h]Prenatal care entry adjusted by 1 month for observations with a preterm birth claim to account for shorter gestation.

[i]Any inpatient hospital claim occurring before (prenatal) or after (postpartum) delivery hospitalization.

[j]Any emergency claim occurring at any point in the observation period.

CHIP, Child Health Insurance Program; CM, Clinical Modification; FPL, federal poverty level; HDP, hypertensive disorders of pregnancy; ICD, International Classification of Diseases; MLIF, Medicaid for low-income families; OBGYN; PNC, prenatal care; SOBRA, Sixth Omnibus Reconciliation Act.

have received effective preventive care that lowers their likelihood of an HDP diagnosis during pregnancy. While other research has discussed similar differences in preventative care, timeliness of PNC, and adverse pregnancy outcomes, including mental health conditions, between publicly and privately insured women, our study found differences even among women all receiving Medicaid.[35–37]

Women without preconception coverage are more likely to delay or have inadequate PNC compared with women with preconception coverage, though differences exist by race and ethnicity and state Medicaid eligibility requirements for maternity recipients.[38–40] Medicaid expansion has been implemented in many states with the goal of increasing preventative care and PNC use, but results from national data on postexpansion utilization of reproductive and maternity care are mixed, suggesting factors beyond insurance coverage affect care utilization among women of childbearing age.[41–43] Regardless, Alabama is not a Medicaid expansion state and maintains more stringent Medicaid eligibility requirements than even other nonexpansion states.[25]

Evidence for racial and ethnic disparities in obstetric care has been established in the literature, including variable receipt of PNC and adverse maternal outcomes, similar to findings observed in our study investigating HDP.[33,34] Although racial and ethnic groups are heterogeneous and reflect social constructs with little biological or anthropological relevance, trends by race and ethnicity are still meaningful.[44] We found that Black women had greater odds and Hispanic women had lower odds of HDP diagnosis, but further analyses are needed to determine how these disparities are influenced by differences in care provision. Nationally, Black and Hispanic women are less likely to enter PNC in the first trimester and to receive adequate PNC compared with White women, similarly to our study sample.[45,46]

Additionally, Black and Hispanic women, especially those with hypertension, are more likely to experience discrimination in prenatal care than White women.[47] The disparities in HDP by race and ethnicity observed in this study are consistent with other southern states;[48–50] however, variation in timing of PNC entry by race and ethnicity is not consistent in some U.S. regions.[51] For example, racial and ethnic differences in PNC entry were not observed after controlling for other maternal characteristics among Medicaid recipients in California, a state with higher first trimester PNC entry rates and less stringent Medicaid eligibility requirements than in southern states.[52] These regional variations could indicate geographic differences in the availability and provision of care among minority populations related to systemic bias and racism, especially considering the high rates of poverty and limited access to health insurance among minority populations in the South.[44,53]

Medicaid care coordination in the maternity population has been researched as a promising strategy in other contexts to improve PNC timing and management of medical comorbidities–including HDP–as well as to reduce disparities in obstetric care. This is especially relevant considering that half of births in the U.S. and the majority of births in the South are paid for by Medicaid.[54] In a study examining maternity Medicaid beneficiaries in Wisconsin, Black race, Hispanic ethnicity, and chronic hypertension were associated with higher odds of receiving Medicaid care coordination services, although results differed between urban and rural counties.[55] Maternity Medicaid care coordination in Oregon was associated with significant increases in early PNC entry

Table 2. Hierarchical Generalized Linear Models of Having Any Hypertensive Disorder of Pregnancy Diagnosis Claim Among the Alabama Medicaid Maternity Population, Presented as Adjusted Odds Ratios and 95% Confidence Intervals, 2017

	County intercept only n = *29,931*	*Model 1* n = *29,931*	*Model 2* n = *29,931*	*Model 3*[a] n = *29,925*
Sociodemographic				
Age				
<19		0.87 (0.76–1.00)	**0.86 (0.75–0.99)**	0.87 (0.75–1.00)
19–24		ref.	ref.	ref.
25–29		**1.19 (1.11–1.27)**	**1.10 (1.02–1.17)**	**1.10 (1.03–1.18)**
30–34		**1.63 (1.50–1.77)**	**1.39 (1.28–1.52)**	**1.40 (1.29–1.52)**
>34		**2.46 (2.21–2.73)**	**2.00 (1.79–2.24)**	**2.02 (1.80–2.25)**
Race/ethnicity[b]				
White		ref.	ref.	ref.
Black		**1.30 (1.22–1.39)**	**1.25 (1.16–1.33)**	**1.24 (1.16–1.33)**
Hispanic		**0.54 (0.44–0.67)**	**0.55 (0.44–0.68)**	**0.55 (0.44–0.68)**
Other		0.93 (0.82–1.06)	0.96 (0.85–1.09)	0.96 (0.85–1.10)
Eligibility type[c]				
MLIF		ref.	ref.	ref.
SOBRA		1.02 (0.96–1.08)	**1.09 (1.02–1.15)**	**1.08 (1.02–1.15)**
CHIP		1.15 (0.96–1.37)	**1.20 (1.01–1.44)**	1.20 (1.00–1.44)
Disability		**1.54 (1.36–1.74)**	**1.28 (1.12–1.46)**	**1.28 (1.12–1.46)**
Clinical[d]				
Obesity			**2.99 (2.78–3.21)**	**2.99 (2.79–3.22)**
Preexisting diabetes			**2.26 (1.91–2.67)**	**2.26 (1.90–2.67)**
Gestational diabetes			**1.62 (1.46–1.78)**	**1.61 (1.46–1.78)**
Any mental health condition			**1.27 (1.19–1.36)**	**1.27 (1.19–1.36)**
Care				
Trimester PNC entry[e]				
First				ref.
Second				**1.10 (1.03–1.18)**
Third				0.96 (0.85–1.09)
None				**0.72 (0.55–0.95)**
Additional county effects				
County Medicaid enrollment[f]				
Low				ref.
Medium				1.09 (0.90–1.32)
High				1.10 (0.93–1.30)
Fit statistics				
Level 2 intercept	0.064* (0.015)	0.058* (0.014)	0.053* (0.014)	0.051* (0.013)
–2 log likelihood	31,406.24**	30,858.71**	29,476.54**	29,453.35**

Source: Alabama Medicaid administrative claims, 2017.

Bold text indicates odds ratios with 95% confidence intervals that do not include the null value of 1.

*$p < 0.0001$; **likelihood ratio test significant; ICC = 0.019; values based on SAS PROC GLIMMIX nested at the maternal residence county level; level 2 intercept entries show county-level parameter estimates with standard errors in parentheses; estimation method = laplace, distribution = binary, link = logit; outcome modeled: having any hypertensive disorder of pregnancy diagnosis code (ICD-9-CM: ''642'' and ICD-10-CM: ''O10, O11, O12, O13, O14, O15, and O16'').

[a]Best fitting model.

[b]Non-Hispanic unless otherwise noted.

[c]MLIF: household income below 18% FPL for parents and caretakers only; SOBRA: household income below 146% FPL if pregnant; CHIP: household income below 317% FPL if <19 years of age; disability: encompasses individuals on Supplemental Security Income or disability or other unspecified category.

[d]Captured using corresponding ICD-9 and ICD-10-CM diagnosis and procedure codes.

[e]Prenatal care entry adjusted for observations with a preterm birth claim to account for shorter gestation.

[f]Low (<25%), medium (25%–29%), and high (>29%) based on proportion of county residents insured by Medicaid for at least 1 month during 2017.

ICC, intraclass correlation coefficient.

and reduced disparities in PNC entry between publicly and privately insured women after controlling for hypertension and other comorbidities.[56] Similar Medicaid care coordination strategies could be useful in increasing early diagnosis of HDP in the South, especially considering that southern states have a larger proportion of women who are Black and who have HDP, both of which seem to benefit from care coordination strategies. However, it is worth noting that more upstream interventions (*i.e.,* during the preconception period) are needed to address the life course nature of adverse pregnancy outcome, such as HDP.

We recognize limitations to our findings inherent to studies using claims data. First, the restricted number and type of variables in Medicaid claims data limited the descriptive ability of these analyses. Greater than 15% of observations had missing data for PNC provider, including the majority of Hispanic women, and only county-level poverty data were available, which restricted the ability to examine more granular geographic relationships. Second, all HDP diagnosis codes were combined into one composite HDP variable without respect to timing of diagnosis. As a result, we were unable to determine whether differences in HDP diagnosis were related to differential time under observation or to clinical disease. For example, initiating PNC in the third trimester was associated with lower odds of any HDP diagnosis in our sample, whereas the clinical expectation would be higher odds of HDP later in pregnancy. While this measurement limited the interpretation of results for specific HDP diagnoses and their timing, using administrative data to estimate HDP rates has been validated in population-level databases.[57,58]

Lastly, the generalizability of this study is limited to Medicaid recipients in Alabama; however, other states who have not expanded Medicaid, especially in the South, have similar population and system characteristics and could find these results valuable.[17,59] We were not able to consider the influence of recent changes to hypertension diagnostic criteria by the American College of Cardiologists and American Heart Association (ACC/AHA), which occurred after our observation period, but the prevalence of chronic hypertension among pregnant women is expected to increase as a result.[60,61]

Conclusion

We found that among women with a delivery claim covered by Alabama Medicaid in 2017, certain maternal characteristics were associated with an HDP diagnosis. Women who entered PNC in the second trimester and those without preconception insurance coverage had greater odds of having an HDP diagnosis. Moreover, the odds of HDP diagnosis were higher among Black women and lower among Hispanic women compared with White women above and beyond other individual and care factors. Future studies should investigate how these systematic differences in HDP outcomes by race and ethnicity are related to differences in care for minority populations. Future studies should also examine trends in HDP over time to better understand how the diagnosis of HDP is changing in light of the new ACC/AHA guidelines, as well as the effect of Medicaid expansion on rates of HDP nationwide.

An enhanced understanding of the factors that influence these phenomena, and whether they are consistent in other settings and populations, could inform policy interventions to reduce the burden of HDP and decrease costs associated with its treatment, especially for minority women insured by Medicaid. Identifying gaps in public insurance could help secure resources for the most marginalized populations, such as through the expansion of Medicaid, and direct and coordinate public health efforts to improve women's health in the South.

Authors' Contributions

M.D.M. and J.M.B. conceived of the study and conducted data cleaning and analysis. M.S.W. and S.E.M. provided subject matter expertise and interpretation of findings in the context of perinatal and women's health literature. All authors drafted the article and helped to conceptualize ideas, interpret findings, and review drafts.

Author Disclosure Statement

No competing financial interests exist.

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