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Prenatal Depression: Assessment and Outcomes among Medicaid Participants

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Abstract

This study used bivariate and regression-adjusted analyses of participant-level survey and medical data to investigate prevalence of depression among pregnant Medicaid participants, correlates of depression, and the relationship between depression and pregnancy outcomes. The sample included Medicaid participants with a single gestation and valid depression data who were enrolled in Strong Start for Mothers and Newborns 2, a national preterm birth prevention program, from 2013 to 2017 (N = 37,287; 85% of total enrollment). Depression rates in Strong Start were high (27.5%). Depression was associated with being black; having other children, an unplanned pregnancy, or challenges accessing prenatal care; not having a co-resident spouse or partner; and experiencing intimate partner violence. After these and other risk factors were controlled for, depression remained associated with higher rates of preterm birth. Systematic screening and holistic approaches to prenatal care that address depression and associated risks could help reduce rates of preterm birth and other poor pregnancy outcomes.

Keywords: Pregnancy, Depression, Preterm birth, Medicaid

Introduction

Major depression is common among women of reproductive age.¹ Between 10 and 23% of women 18 and older have experienced symptoms of depression, which often include sleeplessness, hopelessness, and low energy.^{2,3} These and other associated symptoms decrease quality of life and can lead to other social and health problems for individuals and families. Depression raises risk of suicide as well as risks of death from medical causes such as heart disease.⁴ Despite depression's seriousness, screening for depression is underutilized, which precludes treatment and efforts to

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prevent escalation of symptoms and associated consequences.⁵ Even when depression is diagnosed, it often remains untreated.⁶ Although women would ideally receive screening and treatment prior to conception, many women enter pregnancy with untreated depression.⁷

Contrary to speculation that pregnancy provides protection from depression, research indicates that when women are assessed, between 6.5 and 13% of women screen positive for prenatal depression and that depression rates are similar among pregnant women and comparable non-pregnant women.^{8–11} Furthermore, evidence suggests that overall rates of prenatal depression are increasing and depression is more prevalent among mothers facing poverty and other social disadvantages.^{12,13} Despite these trends, prenatal depression remains overlooked and undertreated, particularly among Medicaid participants.¹⁴

Concerns about the prevalence and risk associated with perinatal depression (antenatal and postpartum) have led the U.S. Preventive Services Task Force (USPSTF) to recommend that “clinicians provide or refer pregnant and postpartum persons who are at increased risk of perinatal depression to counseling interventions.”¹⁵ Depression during pregnancy can have substantial impacts on both a woman and her developing fetus. For instance, prenatal depression is associated with slower fetal growth, miscarriage, low birthweight, preterm labor, preterm birth, maternal anemia and diabetes, hypertensive disorders (including preeclampsia), C-section, and postpartum depression.^{8,12,16,17} Infants born to mothers with prenatal depression can be more irritable, less engaged, and have a higher likelihood of developmental delays.^{8,18} Prenatal depression also increases risk for postpartum depression, and ongoing maternal depression can have additional negative effects on child health and development.^{19,20} Despite serious impacts of prenatal depression, and the potential that adequate screening and treatment could help to prevent poor birth outcomes, research has often focused solely on postpartum depression.^{21,22}

This paper examines prenatal depression and its association with adverse outcomes among Medicaid and Children’s Health Insurance Program (for simplicity, herein, we refer only to Medicaid) beneficiaries who participated in the Strong Start for Mothers and Newborns 2 prenatal care initiative (Strong Start). Funded by the Center for Medicare and Medicaid Innovation through Section 1115A of the Social Security Act, Strong Start supported enhanced prenatal care through three outpatient models: birth centers, group prenatal care, and maternity care homes. All women who sought care at a Strong Start site and were eligible for Medicaid could enroll. Women enrolled in Birth Centers received prenatal care following the midwifery model, a holistic, wellness approach to pregnancy and birth. This model is generally more time intensive than typical care and includes psychosocial support, nutrition counseling, and health education. Strong Start participants receiving Birth Center care also met with a “peer counselor” who provided additional support and referral to community resources. Strong Start awardees implementing group prenatal care predominantly used the CenteringPregnancy approach, an evidence-based model of group prenatal care in which comprehensive prenatal care is provided in a group setting rather than typical one-on-one interactions.²³ Facilitated sessions cover a broad range of issues including nutrition and exercise, stress reduction, family planning, childbirth preparation, and parenting. Maternity care home awardees supplemented typical clinical care with care coordination and other services. Common services among all models included care management; community resource referrals; and intensive support from clinicians, ancillary staff, and peers.

Overall, Strong Start was designed to reduce preterm birth and low birthweight among pregnant women enrolled in Medicaid. The program began in 2013 with funding for 27 awardees operating over 200 sites in 32 states, the District of Columbia, and Puerto Rico.²⁴ Awardees, which included health systems, state agencies, community clinics, and medical practices, provided services for up to 4 years; all program births occurred by early 2017. The women who enrolled commonly faced numerous psychosocial health-related risks in addition to being low income (e.g., housing and food insecurity) and most lived in regions with particularly high rates of preterm birth relative to national rates. At intake, which occurred during the first trimester for the majority, women completed an intake form that included demographics and risks assessments, including a depression screening (a shortened version of the Center for Epidemiological Studies – Depression (CES-D) scale).

This study uses data collected through the Strong Start initiative to investigate the prevalence of prenatal depression, correlates of prenatal depression, and the relationship between prenatal depression and pregnancy outcomes among pregnant Medicaid beneficiaries enrolled in Strong Start. Documenting the incidence of prenatal depression among a national sample of Medicaid-enrolled pregnant women (who account for nearly half of all US births) strengthens evidence of the association between prenatal depression and poorer birth outcomes.²⁵

Methods

Data

Data collection for the national Strong Start evaluation began in 2013, with approval from the²⁴ Institutional Review Board and continued through the end of the program in 2017. The mixed methods evaluation included individual-participant data collection, qualitative case studies, and birth certificate and Medicaid claims data analysis. All Strong Start participants were asked to complete surveys at intake (typically their first or second prenatal care appointment), during their third trimester (between 32 and 36 weeks), and postpartum (within 10 weeks of delivery). This paper considers data from (1) the intake survey form, which included a depression screen and multiple demographic questions and needs assessment tools (e.g., food security), (2) the postpartum survey, which asked about breastfeeding initiation, and (3) a medical chart review completed by Strong Start staff following program discharge. See²⁶ for additional detail on evaluation methods and copies of each form.

Women ever-enrolled in Strong Start were included in the analytic sample if they had a single gestation and non-missing depression data ($N = 37,190$; 82% of total enrollment). Adjusting for women's characteristics and analyzing outcomes, further limits the sample to women with non-missing data for these outcome and control variables. As such, the sample size for the models estimating the association between women's characteristics and depression, associations between depression and birth outcomes, and depression and postpartum initiation of breastfeeding are smaller than the overall sample ($N = 32,409$, $N = 23,980$, and $N = 16,428$, respectively). See Table 1 for details on the construction of the analytic samples. To limit the number of women excluded due to missing data, a missing category is included for covariates where 2% or more of the sample is missing; however, we cannot accommodate participants with missing outcome data (e.g., gestational age). Approximately 23% of all Strong Start participants left Strong Start prior to delivery for reasons such as miscarriage, moving, or loss to follow-up; such women contribute to the share missing outcome data. This study does not include data on treatment for depressive symptoms or prior history of depression.

The prenatal depression measure in this study relies on women's responses to the shortened version of the Center for Epidemiological Studies-Depression (CES-D) scale which was included on the Strong Start intake form.²⁷ This form, completed at entry to the program, was usually self-administered. Women whose total score was 8 or higher screened positive for depression, even if they did not complete all items. Women who partially completed the scale but did not score 8 or higher were considered missing. Though an official diagnosis of depression requires a clinical consultation, women who scored an 8 or higher on the scale are referred to as "depressed," rather than "expressing depressive symptoms," throughout this paper. Per the USPSTF recommendations, women who screen positive for depression could be considered "at risk," and therefore should be referred for counseling or other interventions.

Maternal and infant outcomes measured in this study are preterm birth, low birth weight, Caesarean section (C-section), and postpartum breastfeeding initiation. Preterm birth and low birth weight are defined as estimated gestational age < 37 weeks and birthweight < 2500 g, respectively. These measures and the indicator for C-section are drawn from the medical chart review. Initiation of breastfeeding is drawn from women's self-reports on the postpartum survey.

Table 1
Construction of analytic samples

Logic for dropping observations	# excluded observations	# of remaining observations
Rates of depression analysis		
Strong Start participants	-	45,316
Dropping participants with multiple gestations	607	44,709
Dropping participants without an intake form	2217	42,492
Dropping participants missing depression variable	5302	37,190
Final analytic sample (82.1% of Strong Start participants)	-	37,190
Characteristics associated with depression analysis		
Strong Start participants	-	45,316
Dropping participants without an exit form	831	44,485
Dropping participants without an intake form	2299	42,186
Dropping participants with a miscarriage or elective termination	1330	40,856
Dropping participants with multiples	585	40,271
Dropping participants missing depression variable	4946	35,325
Dropping participants missing any covariates	2916	32,409
Final analytic sample (71.5% of Strong Start participants)	-	32,409
Depression and maternal and infant outcomes analysis ^a		
Strong Start participants	-	45,316
Dropping participants without an exit form	831	44,485
Dropping participants without an intake form	2299	42,186
Dropping participants with a miscarriage or elective termination	1330	40,856
Dropping participants with multiples	585	40,271
Dropping participants missing depression variable	4946	35,325
Dropping participants missing an outcome variable	9577	25,748
Dropping participants missing any covariates	1768	23,980
Final analytic sample (52.9% of Strong Start participants)	-	23,980

Authors' analysis of Strong Start data. ^a The final analytic sample for breastfeeding initiation is further reduced due to missing postpartum forms and item non-response, resulting in a final analytic sample of 16,428 (36.3% of Strong Start participants)

Finally, the analysis includes measures of race/ethnicity, age, education, relationship status, employment/school status, prior preterm birth, prior low birthweight birth, prior C-section, interpregnancy interval, food insecurity, pregnancy intention, pre-pregnancy hypertension, pre-pregnancy diabetes, body mass index (BMI) at first prenatal visit, smoking, history of intimate partner violence (IPV), region, delivery year, and Strong Start model of care. All of these measures are drawn from women's self-reported responses on the intake form, with the exception of region, year, and Strong Start model, which are drawn from the medical chart review. Copies of all forms and additional details on their use and interpretation are available at ²⁶.

Statistical analysis

This research employs quantitative analyses to investigate prenatal depression in Strong Start. It first describes the rate of prenatal depression among participants based on enrollee responses to the CES-D, then use bivariate analyses to examine how rates of depression vary by women's

demographic, social, and medical characteristics. Further investigation into the relationship between women's characteristics and prenatal depression was done by constructing a multivariable linear probability regression model to identify participant characteristics associated with prenatal depression. Next, this work compares the unadjusted probability of preterm birth, low birth weight, C-section delivery, and initiation of breastfeeding for women with and without prenatal depression using bivariate analyses. Finally, because descriptive findings indicate that many Strong Start participants had high rates of risk factors shown to be associated with prenatal depression, the research team applied linear probability models to estimate the association of prenatal depression with the outcomes of interest after adjusting for women's sociodemographic and psychosocial characteristics and medical risk factors.

For bivariate analyses, significance of differences is tested using two-tailed *t* tests. In regression models, standard errors are clustered at the Strong Start site level. Regression models are linear probability models, rather than logistic models, to allow for ease of interpretation of the mean marginal effect of depression on maternal and infant outcomes. Reported significance indicates a *p* value < 0.01. Multivariate regression models include measures of race/ethnicity, age, education, relationship status, employment/school status, prior preterm birth, prior low birthweight birth, prior C-section, interpregnancy interval, food insecurity, pregnancy intention, pre-pregnancy hypertension, pre-pregnancy diabetes, body mass index (BMI) at first prenatal visit, smoking, history of intimate partner violence (IPV), region, year, and Strong Start model. Details of regression models are presented in Tables 1 and 2.

Results

Descriptively, Strong Start participants exhibit twice the rate of depression than the highest documented rates among US pregnant women generally, with 27.5% of Strong Start participants screening positive at intake (Table 2). Comparisons of depression rates among Strong Start participants by characteristics (Table 2) show that black participants are significantly more likely to be depressed than white participants (34.3% vs. 25.0%), while Hispanic participants are significantly less likely to be depressed (20.8% vs. 25.0%). Women with a prior pregnancy are significantly more likely to be depressed than those without (28.1% vs. 25.9%), as are women whose pregnancy is unintended compared with those who intended their pregnancy (29.9% vs. 21.3%). Women who are married or living with a partner are significantly less likely to be depressed than those not living with their partner or not in a relationship (22.4% vs. 33.8%). Having experienced IPV is significantly associated with depression (47.3% vs. 22.5%). Women who report challenges to attending prenatal appointments are significantly more likely to be depressed than women who report no barriers (37.3% vs. 22.2%). Though the absolute difference is not large, women who are working or in school are significantly less likely to be depressed than women who are not (26.0% vs 28.8%).

Table 3 describes the characteristics of Strong Start participants with and without depression, indicating significant differences between the two groups for all characteristics. Compared with women who do not report symptoms of depression, depressed women are more likely to be black, under 20 years of age, have a high school degree or less education; less likely to be co-residing with their partner and more likely not to have a partner; and more likely to be neither working nor in school. They are also more likely to have had a prior preterm birth, a prior low birth weight birth, a prior C-section birth, and/or an interpregnancy interval of 18 months or longer. They are more likely to report food insecurity, to have pre-pregnancy hypertension or diabetes, to be very obese or report smoking at intake, to report their pregnancy was unintended, and to report a history of intimate partner violence.

The multivariate model estimating the association between women's characteristics and the likelihood of depression finds food insecurity to have the largest association with the probability of prenatal

Table 2

Rates of prenatal depression among Strong Start participants by women's characteristics

	Sample size	Depressed (%)	Not depressed (%)	Percentage point difference
All women	37,190	27.5	72.5	
Race/ethnicity (1.0% missing)				
<i>White</i>	9518	25.0	75.0	--
Black	14,546	34.3	65.7	9.3*** [8.2, 10.4]
Hispanic	10,927	20.8	79.3	-4.2*** [- 5.4, - 3.0]
Other/mixed	1843	26.9	73.1	1.8 [- 0.4, 4.0]
Relationship status (1.6% missing)				
<i>Married or living with a partner</i>	20,754	22.4	77.6	--
Not married or living with a partner	15,843	33.8	66.2	11.4*** [10.5, 12.3]
Barriers to prenatal care access (0.0% missing)				
<i>Report difficulty getting to appointments</i>	13,045	37.3	62.7	--
Do not report difficulty getting to appointments	24,145	22.2	77.8	- 15.1*** [- 16.1, - 14.2]
History of intimate partner violence (1.4% missing)				
<i>History of intimate partner violence</i>	7301	47.3	52.8	--
No history of intimate partner violence	29,375	22.5	77.6	- 24.8*** [- 25.9, - 23.7]
Employment and school status (1.7% missing)				
<i>Working or in school</i>	18,807	26.0	74.0	--
Not working or in school	17,753	28.8	71.2	2.8*** [1.9, 3.7]
Prior pregnancy (0.2% missing)				
<i>Women with a prior pregnancy</i>	26,652	28.1	71.9	--
Women without a prior pregnancy	10,454	25.9	74.1	- 2.2*** [- 3.2, - 1.1]
Pregnancy intent (1.5% missing)				
<i>Women with an intended pregnancy</i>	10,680	21.3	78.7	--
Women with an unintended pregnancy	25,947	29.9	70.1	8.6*** [7.6, 9.6]

Authors' analysis of Strong Start data. Italics indicate reference category. Brackets hold 95% confidence intervals. Significance of difference is estimated using two-tailed *t* tests. * $p < 0.10$ ** $p < .05$ *** $p < .01$

depression after controlling for other characteristics (22.7 percentage points, Table 4). Consistent with the comparisons in Table 2, there is also a large association between the probability of prenatal depression and a history of intimate partner violence (18.5 percentage points) and between depression and not being in a relationship at intake (12.4 percentage points).

Table 3
 Characteristics of Strong Start participants by depression status

Characteristic	Depressed	Not depressed	
Race/ethnicity (%)			
Non-Hispanic White	23.6	27.4	***
Hispanic	22.4	32.4	***
Non-Hispanic Black	49.3	35.3	***
Non-Hispanic other/multiple	4.8	4.8	
Age (%)			
< 18 years of age	5.9	5.0	***
18–19 years of age	10.4	9.5	***
20–34 years of age	75.3	76.8	***
35 or more years of age	8.3	8.8	
Education (%)			
Less than high school	26.5	24.8	***
High school degree or GED	56.9	55.0	***
Bachelor's degree	3.9	6.5	***
Other degree	9.0	9.7	**
Unknown education	3.8	4.0	
Relationship status (%)			
Married	16.6	27.2	***
Living with partner	29.4	33.4	***
In a relationship not living together	28.6	25.3	***
Not in a relationship	25.4	14.0	***
Employment and school status (%)			
Working, not in school	31.4	35.2	***
In school, not working	12.2	11.3	**
Working and in school	5.2	5.6	
Neither working nor in school	51.2	47.8	***
Prior preterm birth (%)			
No prior birth	38.9	40.4	**
Prior preterm birth	16.0	11.8	***
No prior preterm birth	45.1	47.8	***
Prior low birth weight birth (%)			
No prior birth	38.9	40.4	**
Prior low birth weight birth	7.0	5.4	***
No prior low birth weight birth	43.2	44.4	**
Unknown prior low birth weight birth	10.9	9.8	***
Prior C-section (%)			
No prior birth	38.9	40.4	**
Prior C-section birth	12.8	11.3	***
No prior C-section birth	48.2	48.3	
Interpregnancy interval (%)			
No prior birth	38.9	40.4	**
< 18 months	14.1	14.0	
≥ 18 months	36.1	35.0	*
Unknown interpregnancy interval	10.9	10.6	
Food insecurity (%)			
No food insecurity	59.9	82.3	***
Food insecurity	35.7	13.2	***

Table 3
(continued)

Characteristic	Depressed	Not depressed	
Unknown food insecurity	4.4	4.5	
Pregnancy intention (%)			
Intended pregnancy	22.3	31.8	***
Unintended pregnancy	77.7	68.2	***
Pre-pregnancy hypertension (%)			
No pre-pregnancy hypertension	83.2	84.6	***
Pre-pregnancy hypertension	6.4	5.2	***
Unknown pre-pregnancy hypertension	10.5	10.2	
Pre-pregnancy diabetes (%)			
No pre-pregnancy diabetes	81.0	83.8	***
Pre-pregnancy diabetes	3.3	2.9	*
Unknown pre-pregnancy diabetes	15.6	13.2	***
BMI at first prenatal visit (%)			
Underweight (< 18.5 BMI)	2.7	2.7	
Normal (18.5–< 25 BMI)	29.4	29.8	
Overweight (25–< 30 BMI)	20.8	22.6	***
Obese (30–< 40 BMI)	23.8	23.2	
Very obese (≥ 40 BMI)	8.0	6.9	***
BMI missing	15.3	14.8	
Smoking (%)			
Did not report smoking at intake	74.8	84.7	***
Reported smoking at intake	17.0	9.0	***
Unknown smoking status	8.2	6.3	***
Intimate partner violence (%)			
No history of intimate partner violence	65.6	85.4	***
History of intimate partner violence	34.4	14.6	***
Year (%)			
2013–2014	22.2	20.9	**
2015	32.9	34.3	**
2016–2017	24.3	26.9	***
Unknown year	20.6	17.9	***
Model (%)			
Maternity care home	58.7	61.9	***
Birth center	17.0	19.7	***
Group prenatal care	24.3	18.4	***
Region (%)			
South	69.2	60.1	***
Northeast	6.7	4.5	***
Midwest	12.1	18.7	***
West	12.0	16.8	***
Sample Size (N = 32,409)	8747	23,662	

Authors' analysis of Strong Start data. Sample limited to women with non-missing data, see Table 1. Significance of difference estimated using two-tailed *t* tests. * $p < 0.10$ ** $p < .05$ *** $p < .01$

Bivariate analyses comparing the unadjusted probability of preterm birth, low birth weight, C-section, and initiation of breastfeeding for women with and without prenatal depression indicate that Strong Start participants who are depressed at intake are significantly more likely than those who are not to have poor birth outcomes (Table 5). Women who screen positive for depression have a 2.5 percentage point higher rate of preterm birth (12.5% vs. 10.0%), a 2.4 percentage point higher probability of their infant being low birthweight (10.9% vs. 8.4%), and a 2.6 percentage point higher probability of C-section birth (28.8% vs. 26.3%) than women who are not depressed. Women who screen positive for depression are also 3.7 percentage points less likely to report initiating breastfeeding postpartum (78.4% vs. 82.2%) than other women.

Though these absolute differences in birth outcomes between depressed and non-depressed women are stark, controlling for women's sociodemographic characteristics (e.g., race/ethnicity, marital status, education), psychosocial characteristics (e.g., smoking, food security, IPV), and medical risk factors (e.g., BMI, diabetes, prior birth outcomes) reduces the associations considerably. Most observed differences by depression status decrease and become non-significant after adjusting for these factors (Table 5). A significant association remains only for the relationship between depression and preterm birth, but the magnitude of the difference decreases from 2.5 to 1.2 percentage points after adjusting for women's characteristics (full regression results and descriptive statistics for the regression sample are presented in Appendix Tables 1 and 2).

Discussion

Preterm birth disproportionately affects women of low socioeconomic status in the USA and is thought to be impacted by psychosocial stressors. Strong Start participants often faced the daily strain associated with not having adequate housing, food, or childcare.²⁴ Moreover, black women, disproportionately represented in Strong Start, face institutional racism and other social burdens that contribute to depression and poor birth outcomes.^{28,29} Strong Start's enhanced prenatal care was designed to address psychosocial needs of women eligible for Medicaid with the intention of preventing poor pregnancy outcomes, particularly preterm birth.

Data collected for the Strong Start evaluation indicate that prenatal depression rates among this population of Medicaid beneficiaries, with more than 25% screening positive, are considerably higher than rates the USPSTF reported for pregnant and postpartum women combined. Though this high rate of prenatal depression highlights a critical need for mental health care among pregnant Medicaid beneficiaries, access to mental health care may be challenging for these women. Medicaid is the US largest mental health care payer, but many mental health providers do not accept Medicaid.^{30,31} The Office of the Inspector General found that more than half of Medicaid managed care mental health providers were not offering appointments because they could not be located, were not participating in the plan, or were not accepting new patients and that many active providers had months-long wait times for appointments.³²

Beyond non-participation in the Medicaid program, some mental health providers are generally reluctant to treat pregnant women, especially those who require medication management.³³ Black women, who face institutional racism and related stressors that contribute to depression and poor birth outcomes, are also less likely to receive minimally adequate mental health care than people of other racial/ethnic groups.^{28,29,34} Interventions to address prenatal depression can be effective among high-risk populations, but prenatal care providers may prefer not to offer depression screenings when referrals are not readily available or if they fear liability resulting from their knowledge of a patient's depression.^{35,36} Even when referred for mental health care, Medicaid-enrolled women may have transportation, childcare, and work-related difficulties accessing services.^{35,37}

Table 4

Characteristics associated with depression among Strong Start participants

Characteristic	Mean marginal effect	95% confidence interval
Race/ethnicity		
<i>Non-Hispanic White</i>	--	--
Hispanic	-2.1	[-4.9, 0.8]
Non-Hispanic Black	6.2***	[3.6, 8.8]
Non-Hispanic other/multiple	1.9	[-1.1, 4.9]
Age		
< 18 years of age	--	--
18-19 years of age	-2.2	[-5.1, 0.7]
20-34 years of age	-4.4***	[-7.1, -1.6]
35 or more years of age	-4.1**	[-7.6, -0.5]
Education		
<i>Less than high school</i>	--	--
High school degree or GED	0.3	[-1.6, 2.2]
Bachelor's degree	-2.6*	[-5.4, 0.1]
Other degree	0.0	[-2.5, 2.6]
Unknown education	-0.5	[-3.7, 2.8]
Relationship status		
<i>Married</i>	--	--
Living with partner	2.4***	[1.3, 3.6]
In a relationship not living together	5.4***	[3.8, 7.0]
Not in a relationship	12.4***	[10.5, 14.3]
Employment and school status		
<i>Working, not in school</i>	--	--
In school, not working	0.9	[-0.9, 2.6]
Working and in school	0.2	[-1.6, 2.1]
Neither working nor in school	2.2***	[0.9, 3.6]
Prior preterm birth		
<i>No prior birth</i>	--	--
Prior preterm birth	6.9***	[3.1, 10.7]
No prior preterm birth	3.0*	[-0.2, 6.2]
Prior low birth weight birth		
<i>No prior birth</i>	--	--
Prior low birth weight birth	-0.4	[-4.0, 3.2]
No prior low birth weight birth	0.3	[-2.2, 2.7]
Unknown prior low birth weight birth	N/A	N/A
Prior C-section		
<i>No prior birth</i>	--	--
Prior C-section birth	N/A	N/A
No prior C-section birth	-1.4	[-3.2, 0.4]
Interpregnancy interval		
<i>No prior birth</i>	--	--
< 18 months	-0.5	[-2.9, 2.0]
≥ 18 months	-0.3	[-2.2, 1.7]
Unknown interpregnancy interval	N/A	N/A
Food insecurity		
<i>No food insecurity</i>	--	--
Food insecurity	22.7***	[21.1, 24.3]
Unknown food insecurity	4.8***	[2.4, 7.1]
Pregnancy intention		
<i>Intended pregnancy</i>	--	--
Unintended pregnancy	2.8***	[1.4, 4.1]
Pre-pregnancy hypertension		
<i>No pre-pregnancy hypertension</i>	--	--
Pre-pregnancy hypertension	-0.1	[-2.2, 1.9]
Unknown pre-pregnancy hypertension	-4.9**	[-9.7, 0.0]
Pre-pregnancy diabetes		
<i>No Pre-pregnancy diabetes</i>	--	--
Pre-pregnancy diabetes	0.2	[-3.6, 4.0]
Unknown pre-pregnancy diabetes	4.5	[-1.0, 10.0]
BMI at first prenatal visit		

Table 4
(continued)

Characteristic	Mean marginal effect	95% confidence interval
Underweight (< 18.5 BMI)	-1.3	[- 4.2, 1.6]
<i>Normal (18.5-< 25 BMI)</i>	--	--
Overweight (25-< 30 BMI)	-1.2*	[- 2.6, 0.2]
Obese (30-< 40 BMI)	-0.4	[- 1.8, 0.9]
Very obese (≥ 40 BMI)	0.7	[- 1.6, 2.9]
BMI missing	-1.4	[- 4.6, 1.8]
Smoking		
<i>Did not report smoking at intake</i>	--	--
Reported smoking at intake	8.8***	[6.4, 11.1]
Unknown smoking status	3.0**	[0.4, 5.7]
Intimate partner violence		
<i>No history of intimate partner violence</i>	--	--
History of intimate partner violence	18.5***	[16.9, 20.0]
Year		
<i>2013–2014</i>	--	--
2015	-1.1	[- 2.9, 0.6]
2016–2017	-0.8	[- 3.0, 1.4]
Unknown year	1.2	[- 1.1, 3.6]
Model		
<i>Maternity care home</i>	--	--
Birth center	1.8	[- 1.1, 4.6]
Group prenatal care	3.4	[- 1.4, 8.2]
Region		
<i>South</i>	--	--
Northeast	3.6	[- 2.6, 9.9]
Midwest	-6.5***	[- 11.0, - 2.0]
West	-3.2**	[- 5.9, - 0.5]
Constant	11.7***	[6.7, 16.7]
Sample size	32,409	

Authors' analysis of Strong Start data. Sample limited to women with non-missing data, see Table 1. Italics and -- indicate the reference category for a variable. N/A indicates a variable category was omitted from the model due to collinearity. Mean marginal effects estimated using linear probability models with standard errors clustered at the Strong Start site level and reported as percentage point estimates. * $p < 0.10$ ** $p < .05$ *** $p < .01$

Despite Medicaid participants' demographic and elevated social risk, depression screening is not always a component of their standard prenatal care, in part because many communities lack sufficient mental health resources to support these women.³⁸ This was confirmed in interviews with Strong Start providers who did not systematically screen for depression prior to implementation of the initiative.²⁶ Given that Medicaid covers perinatal care for about half of all US births, the shortage of mental health providers combined with the high prevalence of prenatal depression highlight a critical need for pregnant women in the Medicaid program. They also present an important opportunity to potentially prevent poor birth outcomes and improve maternal-infant health through increasing the availability of appropriate mental health care.^{25,31,39}

Findings from Strong Start's evaluation indicate prenatal depression among Medicaid beneficiaries is correlated with circumstances common among women living in poverty.^{10,40} Women enrolled in Strong Start were generally unmarried, neither employed nor in school, and had no post-secondary education. Many women faced food insecurity and had a history of IPV. The unadjusted results show that employed women were less likely to exhibit depression symptoms prenatally, consistent with prior studies indicating that even low-wage work confers mental health benefits and that single mothers report work contributes to their sense of efficacy, dignity, and self-

worth.^{41,42} However, the literature also indicates that it is primarily higher quality jobs (e.g., stable, full time) that are associated with mental health benefits.^{41,43} The results from the Strong Start analysis that show no effects for employment after controlling for other factors indicate the need for further exploration of the relationship between job quality and prenatal depression.

The fact that controlling for poverty-related characteristics erased effects indicates a need to further explore effects of Strong Start's enhanced prenatal care. Strong Start not only provided depression screening for all participants, it also provided psychosocial resources and referrals that could help alleviate life stressors correlated with depression, even when formal mental health services were not accessible.^{30,32} Such attention to the needs of pregnant women may have potential to reduce rates of preterm birth and other poor birth outcomes as well as prevent ongoing health consequences that can have lasting effects for generations.

This study has several limitations. First, although it investigates patterns of prenatal depression for Medicaid beneficiaries, an important population, rates of missing data among Strong Start participants are non-negligible. Chi-square and *t* tests were performed to compare the 21,447 women excluded from the regression sample because of missing outcome variables or missing covariates to those included in the final regression sample. These tests find that the dropped participants do not follow clear or consistent patterns, but suggest both that the women who were excluded from the regression analyses may be at greater sociodemographic and psychosocial risk than those included in the analysis and that they may also be at lower medical risk due to fewer prior adverse birth outcomes. For women excluded due to missing depression or covariate data, non-missing outcomes are worse than for the women included in the analytic sample. If these differences between included and excluded women are systematic, the results may not be representative of all Strong Start participants. For example, if excluded participants with and without depression vary systematically in their birth outcomes, the estimated relationships between depression and birth outcomes may be biased. This is a particular concern for the postpartum breastfeeding initiation analysis, as that sample excludes a greater share of Strong Start participants due to missing data.

Additionally, this analysis is based on women's responses to the shortened CES-D scale, which indicates depressive symptoms but cannot confer a depression diagnosis. Because the data are cross-sectional, this analysis is unable to investigate causal relationships between depression and birth outcomes. Further, this analysis cannot account for the effect of treatment, which could not be measured, when considering the relationship between depression and maternal and infant

Table 5

Differences in rates of maternal and infant outcomes among Strong Start participants by women's depression status

Outcome	Sample size	Depressed	Not depressed	Unadjusted difference	Adjusted difference
Preterm birth (%)	23,980	12.5	10.0	2.5*** [1.6, 3.5]	1.2** [0.3, 2.2]
Low birth weight (%)	23,980	10.9	8.4	2.4*** [1.6, 3.3]	0.7 [-0.2, 1.6]
C-section (%)	23,980	28.8	26.3	2.6*** [1.3, 3.9]	0.3 [-0.9, 1.4]
Postpartum breastfeeding Initiation (%)	16,428	78.4	82.2	-3.7*** [-5.2, -2.3]	0.3 [-1.2, 1.8]

Authors' analysis of Strong Start data. Sample limited to women with non-missing data, see Table 1. Brackets hold 95% confidence intervals. Unadjusted and adjusted differences are reported as percentage point estimates. Significance of unadjusted difference estimated using two-tailed *t* tests. Adjusted differences are mean marginal effects, estimated using linear probability models with standard errors clustered at the Strong Start site level. * $p < 0.10$ ** $p < .05$ *** $p < .01$

outcomes. Finally, omitted variables associated with both depression and poor outcomes may bias estimated associations. Despite these limitations, this analysis provides useful information to expand understanding of prenatal depression among women eligible for Medicaid coverage, particularly in regions where preterm birth rates are high.

Implications for Behavioral Health

Women's circumstances and their mental health are inextricably tied both to one another and to their pregnancy outcomes. As such, addressing the psychosocial needs of pregnant women (including depression) could be an important tool in efforts to prevent poor birth outcomes.⁴⁴ In step with the USPSTF recommendations, referral to clinical care or other interventions could be an important step in interrupting this cycle, especially for low-income women and black women of all socioeconomic backgrounds. Approaching prenatal care in a manner that includes social support and mental health services in addition to clinical prenatal care should be considered a routine component of high-quality maternity care. Furthermore, by intervening during the prenatal period, there could be an opportunity to affect postpartum depression, which, as, noted earlier, is an issue of great concern.

These findings show that, after accounting for other observable characteristics, prenatal depression is significantly associated with a higher probability of preterm birth. Preterm birth is associated with many short- and long-term consequences, including infant mortality and health issues such as respiratory problems and developmental disabilities. Preterm birth can be expensive in the short term because of NICU stays, and its associated conditions can create lifelong health expenses and family stressors.⁴⁵ Given preterm birth's adverse short- and long-term effects, providing adequate resources for identifying and treating depression during pregnancy and among reproductive-aged women generally may be a source of ongoing savings and increase in quality of life. Women eligible for the Medicaid program, who currently experience both higher-than-average rates of depression and more limited access to mental health services, have a particular need for improved access to depression treatment in order to prevent escalation of symptoms, depression that persists postpartum, and potential lifelong consequences for children that can result when maternal depression is not adequately addressed.

Bivariate analyses indicate an association between depression and poor birth outcomes in addition to preterm birth, but this relationship is no longer observed for low birthweight, C-section, and breastfeeding initiation after demographic, social, and medical risk factors are controlled for. Many of these risks are associated with common life circumstances among women participating in the Medicaid program. These findings, including identification of high rates of depression among pregnant Medicaid beneficiaries, demonstrate the importance of routine prenatal depression screening along with readily accessible, evidence-based mental health care.

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