

Abstract

Purpose: Maternal adverse childhood experiences (ACEs) are an antecedent risk during prenatal and postpartum periods. We examined race-based differences of the mediating influences of antepartum health risks (prenatal depression, high blood pressure, gestational diabetes) on associations between ACEs and maternal and birth outcomes (postpartum depression, preterm birth, low birthweight) among American Indian and non-Hispanic White women.

Methods: Public use data from the South Dakota Pregnancy Risk Assessment Monitoring System PRAMS (2017–2019) were used for this secondary analysis of postpartum women. ACEs and depression were measured based on self-report survey results. Antepartum risks and birth outcomes were extracted from birth certificate data. A moderated mediation logit model estimated direct, indirect, and moderating effects by race, controlling for maternal characteristics and perinatal risks to understand ACEs' impact on pregnancy and birth outcomes between groups.

Results: The sample included 2,343 postpartum women. American Indian versus non-Hispanic White women had a higher mean ACE score (3.37 vs. 1.64) and substantial disparities. Race-based differences were attributed to social, economic, and health-related factors. Adjusting for proportional differences, members of both groups with ACEs demonstrated significantly increased odds of prenatal and postpartum depression. ACEs influenced postpartum depression and preterm birth through the indirect effect of prenatal depression in both races. Prenatal depression indirectly influenced the relationship between ACEs and low birthweight in non-Hispanic White women.

Clinical Implications: ACEs were associated with higher levels of prenatal depression, which may negatively influence maternal and birth outcomes in American Indian and non-Hispanic White women. Improving perinatal outcomes must emphasize psychosocial care along with medical care to address the high burden of maternal ACEs in the United States.

Key words: Adverse childhood experiences; Low birthweight; Mental health; Postpartum depression; Pregnancy; Premature birth.

INFLUENCE OF MATERNAL ADVERSE CHILDHOOD EXPERIENCES ON BIRTH OUTCOMES IN AMERICAN INDIAN AND NON-HISPANIC WHITE WOMEN

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Adverse childhood experiences (ACEs) are a major maternal health concern, increasing risk for poor perinatal outcomes (Leeners et al., 2014). Women with four or more ACEs have an increased risk of depression, preterm birth, and low birthweight (Mersky & Lee, 2019). American Indian (AI) women are particularly vulnerable to the stress of social and health inequities that can increase the risk of adverse maternal health outcomes (Giano et al., 2021), and experience higher rates of poor birth outcomes than women of other races and ethnicities in the United States (Artiga et al., 2020). Given that perinatal and postnatal outcomes are affected by biomedical and psychosocial influences, improving peripartum outcomes should consist of the psychological and social risk as well as the physiological factors that affect birth outcomes (Olsen, 2018). The purpose of this study is to examine the impact of ACEs on pregnancy and birth outcomes, comparing a representative sample of AI and non-Hispanic White (NHW) women.

AI women are disproportionately exposed to historical and present-day stressors critical to maternal health outcomes (Elm et al., 2019; Walls & Whitbeck, 2011). Racial and traumatic stressors rooted in social and structural inequities (e.g., discrimination, educational and economic disadvantage, ACEs) contribute to pronounced health disparities (Danielson et al., 2018). AI women are at high risk of complications associated with health disparities and experience numerous barriers to prenatal care (Johnson, 2020). Nearly 40% of AI women report more maternal ACEs (2–3 on average) as compared to NHW women (Pro et al., 2020). ACEs combined with other historic stressors

increase risk of intergenerational transmission and poor health outcomes for subsequent generations (Kenney & Singh, 2016).

A growing body of literature suggests that early life stress is associated with poor antepartum health and worsened birth outcomes (Dunkel Schetter, 2011). AI women are exposed to a greater proportion of lifetime risk factors relative to NHW women, which increase risk for pre-eclampsia and gestational diabetes and, in turn, increase the odds of postpartum depression (Azami et al., 2019; Caropreso et al., 2020), preterm birth (Zamora-Kapoor et al., 2016), and low birthweight (Anderson et al., 2016). Although perinatal risk factors, such as health-compromising behaviors, depression, and insufficient perinatal care have been well documented (Olsen, 2018), the pathways of ACEs' impact on antepartum conditions leading to poor birth outcomes are not well understood. To address this gap, we examined race-based differences of the mediating influences of antepartum health risks (e.g., prenatal depression, high blood pressure, and gestational diabetes) on associations between ACEs and maternal and birth outcomes (e.g., postpartum depression, preterm birth, and low birthweight) among AI and NHW women.

Methods

Survey Design

The South Dakota Pregnancy Risk Assessment Monitoring System (PRAMS) public use dataset were analyzed

for this cross-sectional study combining survey data from years 2017 through 2019. South Dakota Department of Health partners along with South Dakota State University researchers implemented the Centers for Disease Control and Prevention (CDC)-funded population-based surveillance system. A detailed description of the PRAMS methodology has been published elsewhere (Shulman et al., 2018). Briefly, a random sample of mothers who gave birth to a live-born infant were contacted 3 months after giving birth. Participants were asked to complete a mixed-mode mail and telephone survey assessing their experiences and behaviors before, during, and after pregnancy. All participating PRAMS jurisdictions ask a common set of core questions; however, CDC or state-developed questions were added, including the 10-item ACEs questionnaire and questions about illicit drug use. In South Dakota, mothers in three race strata were sampled: American Indian, non-Hispanic White, and other races (e.g., Black, Chinese, Filipino, Japanese, mixed race, other Asian). According to the Great Plains Tribal Leaders' Health Board representing tribal communities

Maternal adverse childhood experiences are a major maternal health concern that can increase risk for poor perinatal outcomes.



of South Dakota (*About Great Plains Tribal Leaders' Health Board*, 2022), the AI population of South Dakota use American Indian as their identifying description. Between 2017 and 2019, 3,162 mothers were sampled, with an average response rate of 57.9%.

Measures

Adverse Childhood Experiences

The Adverse Childhood Experiences (ACE) questionnaire was developed by Felitti et al. (1998). The 10-item ACE questionnaire asks, "While you were growing up, during your first 18 years of life, did any of the following things happen often or very often?" It includes three categories of abuse (emotional, physical, sexual), neglect (emotional and physical), and household dysfunction (household member with mental illness, substance abuse, and/or incarceration, witnessing domestic violence, parental separation, or divorce). Psychometric properties of the original ACEs scale demonstrated interrelated items with acceptable internal consistency and test-retest reliability for the sum of the items in diverse samples (Karatekin & Hill, 2018). Respondents have the option to select "No" or "Yes" per individual item. A cumulative index was created to sum each person's ACE score (0–10).

Race

Maternal race was self-identified on the birth certificate and assigned to one of three race strata (AI, NHW, and other races). The "other races" category was excluded from this analysis to examine the differential impact of

ACEs on antepartum risks and birth outcomes among a representative sample of AI and NHW women.

Antepartum Health Condition

Three health conditions (yes or no) were independently tested as mediators in the model. Gestational diabetes and high blood pressure were extracted from birth certificate data. Prenatal depression was a self-report variable included in the survey.

Maternal and Birth Outcomes

Postpartum Depression: Postpartum depression was assessed with two questions: 1) Since your new baby was born, how often have you felt down, depressed, or hopeless? and 2) Since your new baby was born, how often have you had little interest or little pleasure in doing things you usually enjoyed with response choices from "always" to "never." A positive response to either question was considered positive for postpartum depression.

Preterm Birth: Gestational ages were calculated from birth certificates. Gestational age less than 37 weeks was classified as preterm birth (PTB).

Low Birthweight: Birthweight was measured in grams as indicated on the birth certificate. A dichotomous variable was created for low birthweight (LBW) if gram >0 and <2,500, or no LBW if gram ≥2,500.

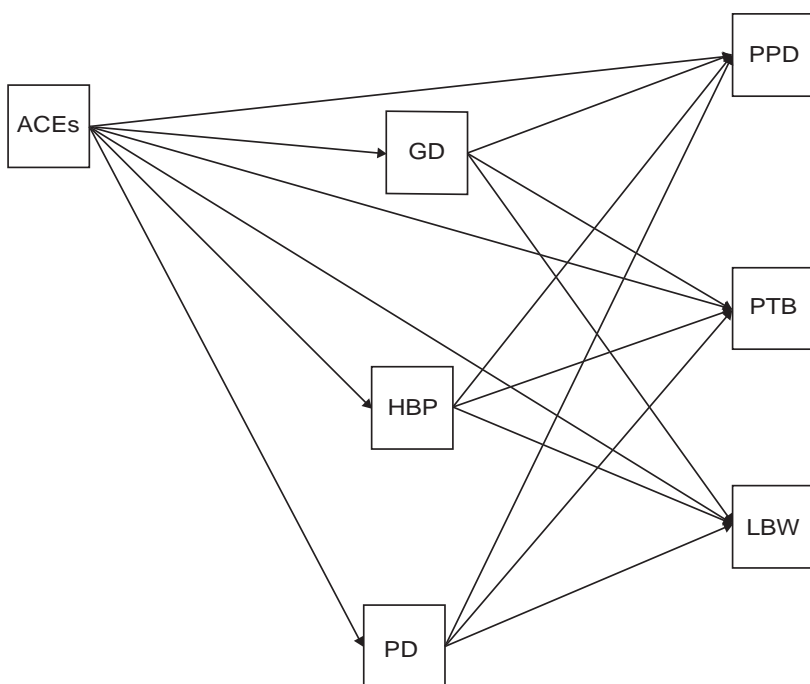
Covariates

Covariates were selected based on their known risk to maternal and birth outcomes and were self-reported unless otherwise specified. Potential confounders included maternal characteristics (e.g., maternal age, parity, maternal education, marital status, and income), and perinatal risks (e.g., previous PTB, perinatal care, feeling threatened or unsafe with spouse or partner [yes/no], smoking in the third trimester [yes/no], drug use during pregnancy, and geographical area [metro/nonmetro]). Perinatal care was based on the Kotelchuck Index, which was obtained from birth certificate data, and determined as adequate plus, adequate, intermediate, or inadequate by two key factors of when perinatal care was initiated, and the number of perinatal visits received.

Analytic Approach

Descriptive statistics were calculated for maternal characteristics, perinatal risk factors, and model variables. Pearson's two-sided chi-square test was conducted to examine significant differences of sociodemographic and risk factors between AI and NHW women. We computed a combined moderated mediation structural logit model (Figure 1; Bauer et al., 2006; Rockwood, 2020)

FIGURE 1. MODERATED MEDIATION LOGIT MODEL



ACEs, adverse childhood experiences; Mediators: GD, gestational diabetes; HBP, high blood pressure; PD, prenatal depression; Maternal and Birth Outcomes: PPD, postpartum depression; PTB, preterm birth; LBW, low birthweight

TABLE 1. MATERNAL CHARACTERISTICS IN AMERICAN INDIAN AND NON-HISPANIC WHITE WOMEN, 2017–2019 SOUTH DAKOTA PRAMS

	American Indian	Non-Hispanic White	χ^2 (df)	<i>p</i>
Total Number, <i>n</i> (%)	785 (33.5)	1558 (66.5)		
Maternal Age (years)				
<20	88 (11.2)	41 (2.6)		
20–24	238 (30.3)	243 (15.6)		
25–34	369 (47.0)	1065 (68.3)		
≥35	90 (11.5)	209 (13.4)	165.3 (3)	<.001
Parity, <i>n</i> (%)				
Yes	496 (74.1)	1,019 (65.4)		
No	162 (24.2)	532 (34.2)	20.09 (1)	<.0001
Marital Status, <i>n</i> (%)				
Married	159 (20.3)	1189 (76.3)		
Not married	626 (79.8)	369 (23.7)	671.5 (1)	<.001
Maternal Education, <i>n</i> (%)				
<High school	265 (33.8)	149 (13.9)		
High school	228 (29.0)	279 (17.9)		
>High school	292 (37.2)	1124 (72.1)	307.9 (2)	<.001
Annual Household Income, <i>n</i> (%)				
<\$16,001–\$28,000	566 (72.1)	321 (20.6)		
\$28,001–\$48,000	85 (10.8)	256 (16.4)		
\$48,001–\$73,000	31 (3.9)	328 (21.1)		
≥\$73,001	20 (2.6)	570 (36.6)	729.3 (3)	<.001

χ^2 : chi-square; *df*: degrees of freedom.

using Mplus Version 8.8 (Muthén & Muthén, 2021). The indirect, direct, and total effects of ACEs on birth outcomes (postpartum depression, PTB, LBW) were examined using three mediating health conditions (gestational diabetes, high blood pressure, prenatal depression) moderated by two racial groups (AI vs. NHW). The mediating measures and endogenous outcomes were treated as binary variables. A robust maximum likelihood estimator was used for bootstrapping standard errors (Tibbe & Montoya, 2022). Generalized boosted modeling was used to assess covariate imbalances across the two races (McCaffrey et al., 2013). Propensity weights were established from the imbalance analysis to provide covariate adjustments for maternal characteristics and pregnancy risk factors.

Results

Sample Characteristics

The study sample of AI (*n* = 785) and NHW women (*n* = 1,558) resulted in an analytic sample of (*N* = 2,343) postpartum women. Maternal characteristics in Table 1 demonstrate significant proportional differences between AI and NHW women. AI women compared to their NHW counterparts were younger, had a previous live birth (74.1% vs. 65.4%), were not married (79.8% vs. 23.7%), had

less than a high school education (33.8% vs. 13.9%), and lived at or below poverty level (72.1% vs. 20.6%). AI versus NHW women had a previous PTB (6.3% vs. 2.5%), were receiving inadequate prenatal care (31.9% vs. 9.2%), were from nonmetro areas (77.5% vs. 48%), felt threatened or unsafe with their husband or partner (11% vs. 2.2%), smoked in the third trimester (21.9% vs. 6.1%), and used one or more illicit drugs during pregnancy (13% vs. 2.4%).

AI versus NHW women had significantly higher rates of prenatal depression (24.3% vs. 14.3%), postpartum depression (24.8% vs. 9.8%), and PTB (11.9% vs. 7.3%). NHW versus AI women had significantly higher rates of gestational diabetes (9.8% vs. 6.9%). A higher percentage of AI women reported one or more ACEs (84.7% vs. 55.1%) and four or more ACEs as NHW women (41.7% vs. 17.8%), with a higher total average mean ACE score of (3.37 vs. 1.64).

Direct Effects

Table 2 (Supplemental Digital Content at <http://links.lww.com/MCN/A85>) and Figure 2 (Supplemental Digital Content at <http://links.lww.com/MCN/A85>) show the adjusted odds ratios of the direct and indirect effects among AI and NHW women. For each one unit increase

in ACE score, AI women had 1.31 increased odds of prenatal depression and 1.12 increased odds of postpartum depression, whereas NHW women had 1.28 increased odds of prenatal depression and 1.14 increased odds of postpartum depression. Race did not moderate the relationships between ACEs and either prenatal or postpartum depression.

For each one unit increase in prenatal depression, AI women had 2.42 increased odds and NHW women had 5.47 increased odds of postpartum depression. AI women had 2.74 increased odds and NHW women had 1.89 increased odds of PTB. NHW women had 2.88 increased odds of LBW. Moderating effects by race demonstrated that for each one unit increase in blood pressure, AI versus NHW women had 5.79 increased odds of PTB, and NHW versus AI women had 6.23 increased odds of LBW.

Indirect Effects

AI women had 1.27 increased odds of prenatal depression influencing the relationship between ACEs and postpartum depression, and 1.31 increased odds of prenatal depression influencing the relationship between ACEs and PTB. NHW women had 1.52 increased odds of prenatal depression influencing the relationship between ACEs and postpartum depression, and 1.17 increased odds of prenatal depression influencing the relationship between ACEs and PTB. NHW women had 1.30 increased odds of prenatal depression influencing the relationship between ACEs and LBW. There were no moderating indirect effects between AI and NHW women.

Discussion

We examined the moderated mediating effects of antepartum health conditions on the relationships between ACEs and maternal and birth outcomes comparing AI and NHW new mothers from the 2017–2019 PRAMS South Dakota dataset. Though AI women had substantially increased risk of ACEs and other health disparities as NHW women, AI and NHW women were affected by ACEs' impact on birth outcomes. ACEs influenced postpartum depression and PTB through the indirect effect of prenatal depression in both races. Prenatal depression indirectly influenced the relationship between ACEs and LBW only in NHW women. These findings emphasize the importance of recognizing and addressing the consequences of ACEs early in the perinatal period to avert worsened maternal and birth outcomes.

Consistent with prior data (Giano et al., 2021), our results showed AI women experienced higher cumulative ACEs and twice the average mean ACE score as NHW women. AI relative to NHW women demonstrated substantial health disparities with consistently higher exposure to poor social determinants of health, such as economic and educational disadvantage in addition to living in nonmetro regions that may have lacked adequate access to health care and other essential services. AI women also demonstrated higher perinatal risks, including previous PTB, inadequate perinatal care, smoking, drug use, and feeling unsafe with their partner or spouse.

Antepartum health conditions also differed among AI and NHW women, with AI women reporting higher proportions of prenatal depression and high blood pressure. Contrary to other published work (Danielson et al., 2018), NHW versus AI women reported significantly higher rates of gestational diabetes, which is consistent with the average percentage of gestational diabetes reported by race in the published South Dakota PRAMS surveillance data reports for the same years represented in this study (Website of the state of South Dakota Department of Health, 2017–2019).

Birth outcomes revealed further disparities in rates of postpartum depression and PTB between AI and NHW women. AI women were 1.7 percentage points above the national average for PTB, whereas NHW women were 2.9 percentage points below the national average for PTB. Disparities in maternal and birth outcomes are not well understood nor can they be fully explained by sociodemographic, medical, and behavioral risk factors. Thus, more research is needed to clarify these pathways and reduce health inequalities.

Numerous studies have demonstrated higher levels of stress exposure predict higher levels of psychological and physiological distress (Coussons-Read, 2013). In our study, an ACE score increased the odds of prenatal and postpartum depression among AI and NHW women. Prenatal depression increased the odds of postpartum depression and PTB in both races and increased the odds of LBW in NHW women. Stressful life events and prenatal depression are the best predictors of postpartum depression, and increased risk in the etiology of LBW and PTB (Dunkel Schetter & Tanner, 2012). High blood pressure increased the odds of PTB and LBW only in AI women. As the leading cause of PTB and maternal mortality, preeclampsia is a condition disproportionately affecting AI women (Zamora-Kapoor et al., 2016).

Consistent with prior studies (Mersky & Janczewski, 2018), ACEs influenced postpartum depression and PTB through indirect effects of prenatal depression in both races. Prenatal depression partially mediated the relationship between ACEs and postpartum depression, yet fully mediated ACEs and PTB. Among NHW women only, prenatal depression significantly mediated ACEs and LBW, yet both races had comparable odds for LBW. Mediating pathways can illuminate underlying mechanisms for the application of targeted therapeutic interventions and population-level strategies and policies. Our findings highlight the utility of prenatal depression as an important target for intervention and prevention among pregnant women.

Despite overwhelming risks for AI women, race did not exhibit moderating effects for ACEs' impact on birth outcomes suggesting that race-based differences were attributed to the maternal characteristics and perinatal risk factors used to adjust the model. Our findings were similar to Kenney and Singh (2016) whose study demonstrated adjusting for social and economic disparities eliminated ACEs prevalence rate differences. Yet, disparities were disproportionately transferred to the ensuing



Improving perinatal outcomes should emphasize psychosocial care along with medical care and address psychological and social risk as well as physiological factors.

generation evidenced by the AI children who were more likely to have multiple ACEs associated with increased health and behavioral problems and, consequently, an increased need for services compared to NHW children (Kenney & Singh, 2016).

AI women relative to NHW women demonstrated greater risk for high blood pressure, with a higher differential for PTB, indicating additional stressor exposures that may have contributed to elevated blood pressure for AI women. Prior evidence from population studies have shown that AI women are at increased risk of hypertensive disorders, such as preeclampsia, partly due to a higher body mass index (Zamora-Kapoor et al., 2016). Our findings point to the biologically embedded stress burdens rooted in the oppressive histories and other social stressors, including racial discrimination and poverty, experienced by AI women (Berens et al., 2017; Elm et al., 2019). Future research should examine the physiological impact of ACEs-associated health and structural inequities in addition to the intergenerational and historical

traumas on antepartum health conditions and birth outcomes among AI women.

Prior studies suggest screening for ACEs should be a routine part of prenatal care to identify women who could benefit from early, targeted interventions to reduce the burden of maternal stress and to address the consequences of ACEs (Flanagan et al., 2018). ACEs screening has been shown to be feasible and acceptable in perinatal populations, and prenatal care provides an optimal environment to screen for ACEs due to the regular visits that can help build essential trust with prenatal providers (Olsen et al., 2021). Considering that psychosocial risks in pregnancy confer risk to child development outcomes in infancy (Racine et al., 2018), identifying risk and protective factors early in the prenatal period can improve maternal and infant health outcomes (Swedo et al., 2023). The effects of ACEs are modifiable; therefore, maximizing protective relationships, resources, and experiences that promote resilience and recovery can mitigate the negative consequences of ACEs (Hays-Grudo et al., 2021).

Cross-sectional survey data are correlative and not causal, yet findings can identify critical areas for further research. Although a priori power was not conducted, a large sample size provided sufficient numbers to indicate stable parameter estimates. A disadvantage of using available data is that subsequent studies are bound to the methods. The PRAMS questionnaire is a self-administered survey that uses self-report data, which can be subject to

CLINICAL IMPLICATIONS

- Maternal adverse childhood experiences (ACEs) and health inequities are major public health challenges that should be addressed during the prenatal and perinatal periods and, in turn, can have a lasting positive impact on the parent–child attachment relationship.
- Disproportionate exposure to ACEs places AI women at greater risk due to social and structural health inequities; therefore, detecting antecedent and present-day risks and intervening early in pregnancy can bolster birth outcomes.
- ACEs screening has been shown to be feasible and acceptable in perinatal populations. Maternal health practice provides an optimal environment to screen for ACEs due to the regular visits that can help build essential trust with prenatal providers.
- Improving perinatal outcomes must emphasize psychosocial aspects of health by addressing maternal ACEs to lessen harms and prevent future risk that interrupt the intergenerational cycle.
- As the largest group of health professionals, nurses play a key role in reducing ACEs and their negative effects among pregnant and postpartum women by recognizing and assessing for ACEs and responding with trauma-informed care to mitigate the health impacts of toxic stress.

recall and social desirability biases and measurement error. ACEs are more likely to be underreported due to the retrospective nature of the questions, relying on the memory of respondents not characterizing events as traumatic, and the stigma and discomfort associated with certain traumas.

Conclusion

Findings from this study show that maternal ACEs contributed to increased levels of prenatal depression, which can have consequences for birth outcomes. These results underscore the importance of detecting and treating depression early in pregnancy. Addressing maternal ACEs and other health and social inequities can disrupt the intergenerational transmission of risk and support families to flourish from the beginning. ❖

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The authors declare no conflicts of interest.

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