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ORIGINAL ARTICLE

Maternal adverse childhood experiences and antepartum risks: the moderating role of social support

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Abstract

The aims of the current study were to examine the association between maternal adverse childhood experiences (ACEs) and antepartum health risks, and to investigate whether social support moderated this association. It was hypothesized that ACEs would be associated with antepartum health risks; however, social support in the prenatal period would buffer mothers from the deleterious consequences of ACEs. Data from 1994 women (mean age = 31 years) and their infants were collected from a longitudinal cohort recruited in health care offices in Alberta, Canada. Pregnant women completed questionnaires related to ACEs prior to the age of 18 and prenatal social support, and a health care professional assessed the mother's antepartum health risk. ACEs included physical, emotional, and sexual abuse, exposure to domestic violence, as well as exposure to household dysfunction such as parental substance use, mental illness, or incarceration. Regression analyses demonstrated a positive association between ACEs and antepartum health risks. However, a significant interaction between maternal ACEs and social support was also observed. Specifically, women exposed to high ACEs and low social support in pregnancy had high antepartum health risks. However, among mothers who had high ACEs but also high levels of social support, there was no association between ACEs and antepartum health risk. A history of ACEs can place mothers at risk of antepartum health complications. However, a resiliency effect was observed: women with a history of ACEs were buffered from experiencing antepartum health risks if they reported high levels of social support in pregnancy.

Keywords Adverse child experiences · Pregnancy · Social support · Reproductive health

Introduction

Globally, reproductive complications are a serious public health concern. Complications in pregnancy can lead to fetal growth restriction and preterm birth, which are in turn associated with adverse perinatal outcomes such as low birth weight and neonatal death (Divon et al. 1998). In 2013, the infant mortality rate in the USA was 5.96 deaths per 1000 live births (Mathews and MacDorman 2013), and approximately one third of all neonatal deaths were the result of preterm birth (Martin et al. 2013). Moreover, in 2015, the rate of preterm birth was 9.63%, which represents an increase from previous estimates in 2014

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(Martin et al. 2017). Surviving preterm infants are more likely than their full-term counterparts to suffer from lifelong physical health complications and disease, as well as cognitive, neurobiological, and behavioral delays and deficits. As a result, extensive research has been devoted to identifying and understanding risk factors that predict antepartum complications.

One antecedent risk of antepartum complications is maternal history of adverse childhood experiences (ACEs) prior to the age of 18, such as maltreatment history and household dysfunction. The association between ACEs and negative health outcomes such as smoking, alcoholism, obesity, sexually transmitted infections, depression, physical inactivity, and drug abuse (Felitti et al. 1998; Dube et al. 2003; Anda et al. 2006) in adult populations has been well-documented (Dube et al. 2003; Anda et al. 2006; Bellis et al. 2014). There is also a small but growing body of literature examining associations between ACEs and poor antepartum health outcomes in women. For example, women with higher ACEs have been shown to be at greater risk of developing complications in pregnancy than women without exposure to abuse, such as gestational diabetes (5.3 vs. 2.7%), preeclampsia (7.7 vs. 3.6%), and short gestational age (9.4 vs. 7.1%) (Roberts et al. 2013). These antepartum risks put both the pregnant mother and future offspring at considerable risk of current and future health and developmental difficulties (Kahn et al. 2002; McDonnell and Valentino 2016; Smith et al. 2016; Madigan et al. 2017; Racine et al. 2018a, b).

The negative impact of ACEs on antepartum health risk is far from deterministic, as it can be influenced by positive social factors within the individual's environment (Logan-Greene et al. 2014; Font and Maguire-Jack 2016; Narayan et al. 2018). In essence, protective factors have the potential to buffer the impact of ACEs on physical and mental health outcomes (Folger et al. 2017). Several variables have been identified as protective factors for stress associated with pregnancy, with the most notable being social support (Dunkel Schetter 2011). The presence of social support lessens the effect of stress by increasing perceived coping skills and reducing the psychological impact of the stressful experience (Cohen and Wills 1985). Research has shown that social support moderates the impact of prenatal stress on the development of postpartum depression (Denis et al. 2012; Coburn et al. 2016). Despite this theoretical evidence, limited work has empirically examined the influence of maternal social support on the association between ACEs and antepartum health outcomes in women. Identifying potential protective factors that may mitigate poor antepartum health outcomes is critical to inform efforts to reduce health disparities in women of antepartum age.

The current study sought to examine whether maternal social support in pregnancy moderates the association between maternal ACEs and maternal antepartum health risk. It was hypothesized that having more ACEs would be related to high antepartum risk as evaluated by a medical professional. However, we hypothesized that this association would be qualified by an interaction between maternal ACEs and social support during pregnancy: mothers with high maternal ACEs will have lower antepartum risk scores when exposed to high levels of social support in pregnancy.

Materials and methods

Sample

The current investigation is part of a larger prospective pregnancy cohort (All Our Babies/Families; AOB/AOF) (McDonald et al. 2013), which aims to examine the determinants of maternal and infant health outcomes and health care use. Participants were recruited between May 2008 and December 2010 from health care and laboratory offices in Calgary, Canada. Inclusion criteria were being less than 25 weeks gestational age, being at least 18 years of age, receiving prenatal care from health care and laboratory offices through Calgary Laboratory Services, and being fluent in English. A total of 84% of approached women agreed to participate. With consent, information about perinatal risk was obtained from medical health records. Participants were followed in pregnancy (< 25 weeks and around 35 weeks), as well as in the postnatal period at 4, 12, 24, and 36 months of age. Time points used in the current study include < 25 weeks gestation and infant age 36 months for the ACEs measurement. The study was approved by the Child Health Research Office and Conjoint Health Research Ethics Board of the Faculties of Medicine, Nursing, and Kinesiology at the University of Calgary and participants provided written consent to participate.

The current study is based on a subgroup of women who had data available for social support measured at < 25 weeks gestation, the perinatal risk score rated by a health care provider at birth, and maternal report of adverse child experiences at 36 months (ACEs) ($n = 1994$). At 36 months, 69% of eligible women from the original cohort participated. Full attrition characteristics are published elsewhere (McDonald et al. 2013). Consistent with other longitudinal epidemiological studies (Young et al. 2006), attrition analyses revealed women who were lost to follow-up had significantly lower educational attainment ($p < 0.01$) and significantly lower household income ($p < 0.01$). Demographics and participant characteristics are presented in Table 1.

Measures

Maternal adverse childhood experiences

Mothers were asked to report their recall of adverse childhood events using a detailed questionnaire that was tailored for the All Our Families study, but based on the original ACE questionnaire (Felitti et al. 1998). This information was gathered when the child was 36 months of age and was retrospective in nature. Consistent with previous studies (Felitti et al. 1998), questions assessed

Table 1 Study characteristics

	Characteristics	*N* (%)
Maternal ethnicity	White	1631 (81.8%)
	Other	352 (17.7%)
	Missing	11 (0.6%)
Child gender	Female	938 (47%)
	Male	1019 (51.1%)
	Missing	37 (1.9%)
Maternal education	Some elementary school or high school	46 (2.3%)
	Graduated high school	116 (5.8%)
	Some college or university	245 (12.3%)
	Graduated college or university	1250 (62.7%)
	Some graduate school	51 (2.6%)
	Completed graduate school	275 (13.8%)
	Missing	11 (0.6%)
Household income	$39,999 or less	117 (5.9%)
	$49,00–79,999	406 (20.4%)
	$80,000 or more	1394 (69.9%)
	Missing	77 (3.9%)
		Mean ± SD
Maternal age, years		30.87 ± 4.40
Adverse child experiences		1.41 ± 1.45
Prenatal risk score		1.92 ± 1.99
Maternal social support		86.81 ± 14.84

exposure to different types of abuse experienced prior to age 18 including physical, sexual, and emotional abuse, as well as the presence/absence of family dysfunction (e.g., parent mental illness, substance abuse, illicit drug use, incarceration, and domestic violence). There were 11 questions that mapped on to eight categories of adversity. Similar to previous studies (Felitti et al. 1998; Dube et al. 2003; Anda et al. 2006), mothers were categorized as having 0, 1, 2, 3, or 4 or more ACEs. In the current sample, 37.6% of women reported no ACEs, 23.3% reported one ACE, 13.6% reported two ACEs, 10.3% reported three ACEs, and 14.7% of women reported four or more ACEs.

Antepartum health risk

In the province of Alberta, at every birth, an antepartum risk assessment score (Program 2009) is completed by the responsible health care professional (e.g., physician, nurse, or midwife) and is stored electronically by the Alberta Perinatal Health Program. The antepartum risk score is based on a 39-item questionnaire that is used to evaluate the medical risk of women giving birth (Parboosingh 1986). The antepartum risk score includes prepregnancy risk factors, past obstetrical risk factors, problems in the current pregnancy, and other risk factors. Example items include age at delivery, maternal weight, diabetes, heart disease, hypertension, chronic renal disease, other medical disorders (e.g., epilepsy, severe asthma, lupus, Crohn's disease), previous neonatal death or stillbirth, history of abortion, history of cesarean section, bleeding in current pregnancy, gestational hypertension, poor weight gain, smoking, and substance abuse. A weighted value is assigned for each condition in the risk assessment tool, with a higher value used for more severe conditions, and the total score is the sum of all the weighted values. Based on the initial validation (Parboosingh 1986), pregnancies with risk scores of 0 to 2 are considered low risk, scores of 3 to 6 indicate moderate risk, and any risk score above 6 indicates a higher risk pregnancy. The score can range from a low of 0 to a high of 90 if every potential risk item was endorsed. In the current sample, 67.6% of women were low risk, 29.6% had moderate pregnancy risk, and 2.8% had high pregnancy risk.

Maternal social support

Maternal social support was operationalized using the total score of the Medical Outcomes Study Social Support Survey (MOS-SS; Sherbourne and Stewart 1991). The MOS-SS is a 19-item, self-report measure of functional social support and includes four domains: tangible support, positive social interaction, affection, and emotional/informational support. The four domains of social support are defined as follows: (1) emotional/information support refers to the expression of positive affect, demonstrating empathy and encouragement, as well as offering advice, information or feedback; (2) tangible support refers to the provision of material support or behavioral assistance; (3) positive social interaction refers to the availability of other people to socialize with; and (4) affective supports refers to receiving expressions of love and affection from another individual. The MOS-SS has been used extensively in perinatal research and has high psychometric properties (Sherbourne and Stewart 1991). Scores range from 0 to 100 with higher scores indicating higher levels of social support. The internal consistency of the MOS-SS was measured with a Cronbach's alpha of 0.96 in this sample.

Covariates

Demographic information, including maternal education, income, ethnicity, and maternal age, was collected via a self-report questionnaire at the baseline assessment (< 25 weeks survey). Maternal education was scored from 1 to 6, as follows: (1) some elementary school or high school (2.3%), (2) graduated high school (5.8%), (3) some college or university (12.3%), (4) graduated college or university (62.7%), (5) some graduate school (2.6%), or (6) completed graduate school (13.8%). Annual household income before taxes was categorized by increments of $10,000 ranging from less than $10,000 to more than $100,000 (11 categories in total). The average range was $80,000–$89,999. Maternal age ranged from 18 to 45 at the time of recruitment with an average age of 30.87 (SD

= 4.40). Ethnicity was classified as white or "other" with 81.8% of the population self-identifying as white.

Data analysis

Analyses were conducted using MPlus 7.4 and SPSS 22. The demographic, ACEs, and social support variables reported in the current study had minimal missing data (< 5%). For the antepartum risk score, 11.4% of participants had missing data. Analyses were performed with maximum likelihood, which allowed us to include all 1994 participants with missing data based on the missing at random assumption (Graham 2009). The MLR estimator was used, which is robust to non-normality (Yuan and Bentler 2000). Multiple linear regressions were performed in SPSS 22 to test whether maternal social support moderated the link between total maternal ACEs and perinatal health risk. The model included three covariates (maternal age, maternal education, and maternal income), which have been established as risk factors for adverse pregnancy and antepartum outcomes (Fraser et al. 1995). To help interpret the interaction, we performed simple slope analyses, which allowed for the computation of the strength of the association between maternal ACEs, and perinatal health risk for mothers with high (1 SD above the mean) and low (1 SD below the mean) total levels of social support (Cham et al. 2013). All continuous variables were centered to minimize multicollinearity and the interaction term was computed using the centered variables prior to analyses.

In order to provide additional information on the type of social support that would be particularly helpful in moderating the association between maternal ACEs and perinatal health, we conducted post hoc analyses whereby we estimated four additional multiple regression models where each of the four social support subscales (tangible support, affective support, interactive support, and emotional/informational support) were included as the moderator using the same process described above.

Data availability The datasets generated and analyzed during the current study are from the All Our Babies/Families Study (i.e.,http://allourbabiesstudy.com) and have been made available in the SAGE repository by the senior author (Dr. Tough) and are available at https://policywise.com/initiatives/sage/current-data-assets

Results

Descriptive statistics

The means and SDs for all variables are reported in Table 1. Pearson correlations in Table 2 revealed small to medium correlations in expected directions. Mothers with higher education had higher income, were older, and had more social support. Maternal ACEs were associated with lower income, lower education, and less social support in adulthood.

Table 2 Pearson correlations among variables

	1	2	3	4	5
1.Income	1				
2.Maternal education	0.29**	1			
3.Maternal age	0.25**	27**	1		
4.Social support	0.28**	0.07*	− 0.07*	1	
5.Maternal ACEs	− 0.11**	− 0.17**	− 0.05*	− 0.15**	1

*$p < .05$; **$p < .01$

Main analyses

Results from the regression analysis can be found in Table 3. Examining covariates, income and maternal education both negatively predicted antepartum health risk scores at birth, whereby mothers with lower education and lower income had higher antepartum health risk scores. There was a positive association between maternal age and the pregnancy health risk score. With regard to the predictors, after controlling for income, maternal age and education, maternal ACEs positively predicted the antepartum health risk score, with the percentage of women with an at-risk pregnancy (score of 6 or more on the APRS) increasing as the number of ACEs increased (Fig. 1). There was a trend for total maternal perceived social support to negatively predict the antepartum risk score. Finally, the interaction term between maternal ACEs and maternal social support was significant, which indicated that the link between maternal ACEs and perinatal health risk varied as a function of total maternal social support.

In order to explore the nature of the interaction, we plotted the association between maternal ACEs (1 SD above or below the mean) and maternal antepartum risk score at different levels of social support (See Fig. 2). Testing of simple slopes revealed that the association between maternal ACEs and the antepartum risk score was statistically significant at low levels of total social support, but not at high levels of total social support. Thus, for mothers with low levels of social support, having high levels of maternal ACEs predicted higher antepartum health risk scores in pregnancy ($b = 0.17$, $p < 0.001$). For mothers with high levels of social support, having high levels of maternal ACEs was not related to the antepartum risk score ($b = -0.03$, $p = 0.55$).

Post hoc analyses investigating whether the four subtypes of maternal social support would also moderate the association between maternal ACEs and antepartum health risk in pregnancy were also investigated using multiple regression. Analyses showed that tangible support ($b = -0.15$, $p < 0.001$), affective support ($b = -0.12$, $p = 0.01$), interactive support ($b = -0.12$,

Table 3 Regression analysis examining the role of maternal ACEs in predicting APRS scores

Reproductive health risk score	*β*	SE	Z	Two-tailed *p* value
Covariates				
Income	−0.07	0.02	−3.40	< 0.01
Maternal education	−0.14	0.04	−3.06	< 0.01
Maternal age	1.64	0.11	15.50	< 0.01
Predictors				
Total maternal ACEs	0.07	0.03	2.22	0.03
Maternal social support	−0.09	0.05	−1.70	0.09
Interaction				
Total maternal ACEs*maternal social support	−0.12	0.04	−3.05	< 0.02

$p = 0.002$), and emotional/informational support ($b = -0.09$, $p = 0.04$) were all statistically significant moderators of the association between maternal ACEs and the antepartum risk score.

Discussion and conclusions

The current study sought to examine the links between ACEs and antepartum health risks, as well as the protective effect of social support on this association. Results revealed that a history of ACEs can place mothers at risk for antepartum health complications; however, a resiliency effect was observed, where women with a history of ACEs were buffered from experiencing antepartum health risks if they perceived high levels of social support in their pregnancy. Thus, our hypothesis that social support would moderate the association between ACEs and antepartum health risks was supported. Importantly, this pattern was substantiated after controlling for covariates typically associated with pregnancy health outcomes such as maternal age, maternal education, and maternal income. This observed buffering effect of social support is in line with previous research demonstrating the protective effect of social support on other forms of adversity in the prenatal period, such as prenatal stress and depression (Coburn et al. 2016).

Our study contributes to a new understanding of the impact of maternal ACEs on antepartum health risk by demonstrating the cumulative effect of multiple ACE types on antepartum health risk using a large cohort of women. Considerable work in the area has primarily focused on single indicators of abuse, such as the specific impact of childhood sexual abuse on maternal pregnancy risk factors (Leeners et al. 2010). The current study, however, examined the cumulative impact of adversity in childhood, including three different types of abuse, as well as cumulative family dysfunction on antepartum health risk. Research has shown that it is the *cumulative* and *pervasive* nature of stress in childhood that contributes to allostatic load, the "wear and tear" at the biological level (McEwen and Stellar 1993), rather than one individual risk factor in particular. Furthermore, adversity

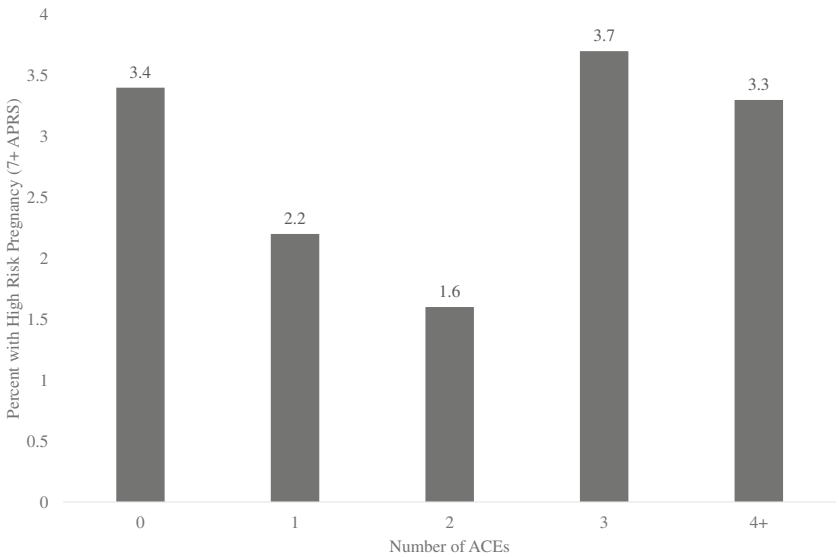

Fig. 1 Maternal ACEs and pregnancy risk. Percentage of women with a high-risk pregnancy score as a function of number of ACEs

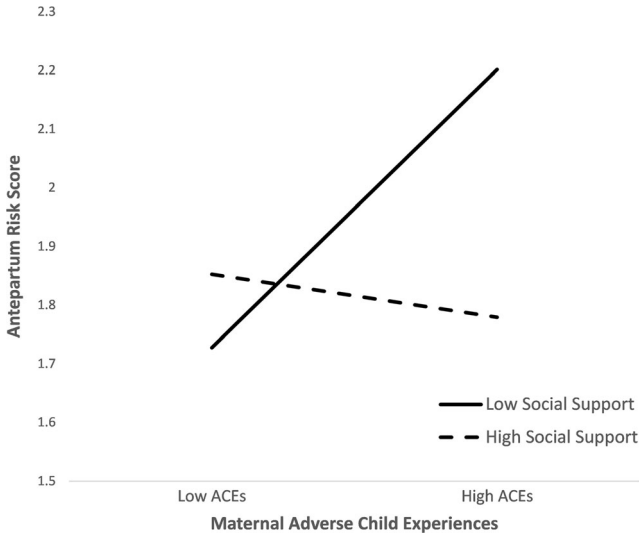

Fig. 2 Interaction effect of maternal ACEs and social support on antepartum risk scores. Antepartum risk score (standardized) as a function of maternal social support in pregnancy and maternal adverse child experiences. Regression lines for relations between prenatal risk score and maternal adverse child experience as moderated by maternal social support (1 SD above and below the mean; two-way interaction). Slope of low social support is significant ($b = 0.17$, $p < 0.001$) but slope of high social support is not ($b = -0.03$, $p = 0.55$)

that occurs in early childhood remains predictive of adverse outcomes later in life, above and beyond risks that occur in later childhood and adulthood (Atkinson et al. 2015). Our finding that higher cumulative maternal ACEs are positively associated with maternal health risk in pregnancy suggests that the intensity and chronicity of stress in childhood is a potential mechanism by which ACEs have an impact on health outcomes.

The current study used a cumulative antepartum risk score as the outcome measure. Previous studies have demonstrated the impact of maternal ACEs on specific individual pregnancy risks, such as gestational diabetes, shorter pregnancy length, preeclampsia, and likelihood of risk behaviors, rather than a cumulative outcome (Roberts et al. 2013). While clinically useful to consider individual risk outcomes, the prediction of individual outcomes also fails to consider the co-occurrence and clustering of antepartum health risks and common biological and psychosocial mechanisms that underlie them (Madigan et al. 2017; Racine et al. 2018a, b). For example, it has been hypothesized that poverty may underlie poor health outcomes in pregnancy as poverty accompanies many risk factors over the course of development (Larson 2007). Although we controlled for family income in the current study, we cannot preclude other social determinants of health as a precipitant for exposure to a constellation of adversity that subsequently leads to poor pregnancy health. Future studies should examine the longitudinal process by which multiple adversities have an impact on antepartum health risk.

Adequate social support in pregnancy has been associated with reduced maternal stress, depression, and anxiety, which are risk factors for poor obstetric and neonatal outcomes (Alder et al. 2007). The current study adds to the body of evidence suggesting that social support can be a powerful buffer in mitigating the long-term impacts of adversity in childhood on birth and child health outcomes by demonstrating that social support in pregnancy is also a buffer for antepartum risk (Hetherington et al. 2015). Social support may exert its effect via a reduction in maternal cortisol, which reduces the excitation of the hypothalamic-pituitary-adrenal axis, in turn, diminishing the stress response associated with antepartum health risks (Giesbrecht et al. 2013). Indirect mechanisms such as life satisfaction and coping likely also play a role. Future research in this area is needed to more fully understand biological and psychosocial mechanisms of this developmental pathway.

Findings in the current study point to social support as a protective factor that mitigates the negative impact of maternal stress in childhood on pregnancy risk factors. Given the strong association between pregnancy risk factors and subsequent infant development and health (Larson 2007; Beijers et al. 2010), these findings underscore the importance for exploring the potential for collecting this information as part of routine prenatal care, if resources and follow-up are in place. Second, our findings suggest that given the inherent stress that is part of pregnancy, directing women to community resources that offer social support in the pre-partum, antepartum, and postpartum periods may help alleviate some of this stress. Social support interventions have long targeted women with high medical risk, but considering exposure to previous psychosocial stressors, particularly ACEs, may identify women who would benefit from interventions designed to improve social support during pregnancy, such as Centering Pregnancy (Rising 1998). Additionally, our findings showed that different types of social support including tangible, affective, interactive, and emotional/informational were all successful in providing a buffering effect for the influence of maternal ACEs on maternal antepartum risk. Interestingly, the largest effect was found for tangible support, which includes material support and behavioral assistance. When counseling women in pregnancy, it may be helpful to emphasize the type of support that may be most helpful in addition to making referrals to services that will provide material and behavioral assistance such as transportation to medical appointments, meal provision and preparation, and assistance with daily chores and tasks in the home.

There are some limitations to the current study. First, although the current study used a large longitudinal cohort, the majority of the mothers who participated were well educated and had high average household family incomes. Thus, the demographics of the current sample reduce the generalizability of the findings to higher risk samples. Second, as is typical in longitudinal studies (Young et al. 2006; Graham 2009), we experienced 30% attrition over the course of the study with mothers who had higher income and higher education being

more likely to remain in the study. The attrition and missing data reported in the current study may have resulted in selection bias, which could impact on the generalizability of the findings. However, if mothers who were lost to follow-up had higher ACEs, our estimates could underestimate this association, lending confidence to our findings. Furthermore, given that child adverse experiences were collected via retrospective report, it is important to consider the possibility of recall and rumination bias (Hassan 2005). Previous research has demonstrated that reports of trauma from childhood are typically underreported retrospectively (Hardt and Rutter 2004); however, a recent study showed that prospective and retrospective reports of child adversity produced similar findings, allaying concerns of recall bias (Patten et al. 2015). Rumination bias is more common in case-control studies than in cohort studies, like the current study (Delgado-Rodriguez and Llorca 2004). Nevertheless, future longitudinal research would benefit from obtaining exposure to adversity in childhood through multiple sources or multiple informants.

Lastly, we included a measure of perceived social support and, as such, the findings from the current study uniquely apply to the perception of social support in pregnant women.

Mothers who were exposed to abuse and dysfunctional family environments as children benefit from social support in pregnancy with regard to their reproductive health outcomes. Given the established implications of prenatal health for birth outcomes including prematurity and low birth weight, mitigating the transmission of the biological risks associated maternal ACEs is imperative. Future studies should further investigate physiological and psychological mechanisms of the association between ACEs and antepartum risks as well as interventions to improve social support for high-risk women.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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