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Associations Between Maternal Exposure to Child Abuse, Preterm Birth, and Very Preterm Birth in Young, Nulliparous Women

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Abstract

Objectives: Preterm birth (PTB) is a leading cause of infant morbidity and mortality. One goal of Healthy People 2020 is to understand the role of preconception lifecourse exposures in relation to pregnancy outcomes, including PTB. The objective of this study was to examine the relationship between maternal exposure to multiple forms of childhood abuse and PTB and very preterm birth (vPTB), utilizing a national, population-based sample.

Methods: This study utilized retrospective self-reported maternal exposure to parent/adult caregiver perpetrated emotional, physical, and sexual abuse; non-parental/adult caregiver perpetrated sexual abuse; and history of PTB and vPTB in the National Longitudinal Study of Adolescent to Adult Health. The cross-sectional analytic study population consisted of first deliveries to 4,181 nulliparous women (mean age at time of delivery= 21.7 years).

Results: With one exception, we did not observe associations between experiences of child abuse and the likelihood of PTB or vPTB. Only sexual abuse, accompanied by physical force and perpetrated by a non-parent/adult caregiver, was associated with an increased odds of vPTB (aOR= 1.94 (95% CI:1.10, 3.44)), particularly in women for whom abuse began after age 9 (aOR=2.32 (95% CI: 1.25, 4.28)).

Conclusions for Practice: The relationship between maternal exposure to child abuse and PTB may be limited to specific abuse and PTB subtypes, namely parent/caregiver perpetrated sexual abuse by force and vPTB. Future studies should also examine possible effect modifiers, such as maternal age and resilience, which may have the potential to inform interventions that can mitigate effects of maternal early life adversity.

Keywords

pregnancy; preterm birth; child abuse; child maltreatment; sexual abuse

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Objectives

Preterm birth (PTB) is the leading cause of infant mortality and morbidity in the United States and may be the most important problem in maternal and child health (Blencowe et al., 2013). Risks of subsequent infant and child morbidity and mortality are even stronger for very preterm birth (vPTB) (Blencowe et al., 2013). Several risk factors for PTB and vPTB have been identified, including African American race (Kramer, Hogue, Dunlop, & Menon, 2011); maternal health conditions such as diabetes (Hedderson, Ferrara, & Sacks, 2003), obesity (Cnattingius et al., 2013;), and maternal depression (Orr, James, & Blackmore Prince, 2002); and history of previous preterm birth (Kazemier et al., 2014). However, most instances of PTB, namely spontaneous PTB, remain unexplained (Blencowe et al., 2013). Thus, the etiology of PTB and vPTB are complex and likely multifactorial, with limited evidence about how to intervene to reduce the risk of PTB/vPTB (Esplin, 2014).

Despite limited evidence pertaining to intervention strategies, data suggest that psychosocial factors, namely stress, are associated with PTB and vPTB (Kramer et al. 2011). Several studies report small, but positive associations between various types of stressors and PTB. Others have proposed that stressors with an onset in early life may exert relatively stronger effects than recent, more transient stressors (Wadhwa, Culhane, Rauh, & Barve, 2001), and modifiable life course stressors have been identified as an important research area for understanding perinatal outcomes, including PTB (Kramer et al., 2011). A relationship between maternal stress and PTB/vPTB is plausible due to evidence of relationships between psychosocial stressors and biological and behavioral pathways implicated as causes of PTB/vPTB. Stress may trigger maladaptive behaviors that are known risk factors for PTB, such as substance use, eating behaviors that lead to underweight or obesity, or exacerbate maternal physical and mental health conditions (Juster, McEwen, & Lupien, 2010; Sinha & Jastreboff, 2013). Stress may also activate biological pathways involved in the timing of parturition. Three such pathways that are particularly relevant to psychosocial stressors include activation of the hypothalamic-pituitary-adrenal axis (e.g., elevated corticotropin releasing hormone), infection/inflammatory pathways (e.g., bacterial vaginosis), and vascular dysfunction (e.g., preeclampsia) (Wadhwa et al., 2001).

Child abuse is a prevalent form of early life stress. Approximately 15–30% of women report histories of exposure to each of the three primary types of child abuse: emotional, physical, and sexual abuse (Centers for Disease Control and Prevention [CDC], 2010). Abuse has been linked to health outcomes throughout the lifecourse including but not limited to vulnerability to psychopathology (Heim, Newport, Miller, & Nemeroff, 2000), obesity (Hollingsworth, Callaway, Duhig, Matheson, & Scott, 2012), and inflammation and cardiovascular outcomes (Rooks, Veledar, Goldberg, Bremner, & Vaccarino, 2012). Maternal exposure to child abuse has also been linked to behavioral and biological factors during pregnancy that are associated with PTB, including mental health sequelae such as depression (Wosu, Gelaye, & Williams), infection/inflammation (Cammack et al., 2011) and dysregulation of the hypothalamic-pituitary-adrenal axis (Moog et al., 2015). Child abuse may be a salient risk factor for PTB since abuse is related to other stressors during pregnancy that increase the risk of PTB, including socioeconomic stressors such as low educational attainment (Ruiz et al., 2015; Tanaka, Georgiades, Boyle, & MacMillan, 2015)

and revictimization via intimate partner violence (Hill, Pallitto, McCleary-Sills, & Garcia-Moreno, 2016; Jennings, Richards, Tomsich, Gover, 2015).

To date, seven studies have examined the relationship between child abuse and PTB (Benedict, Paine, Paine, Brandt, & Stallings, 1999; Grimstad & Schei, 1999; Leeners, Stiller, Block, Gorres, & Rath, 2010; Margerison-Zilko, Strutz, Li, & Holzman, 2016; Noll et al., 2007; Selk, Rich-Edwards, Koenen, & Kubzansky, 2016; Stevens-Simons & Reichert, 1994), and five of these studies offer support for the presence of an association (Leeners et al., 2010; Margerison-Zilko et al., 2016; Noll et al., 2007; Selk et al., 2016; Stevens-Simons & Reichert, 1994). Odds ratios for positive associations ranged between 1.2 and 2.8. Additional related investigations include a study that reported maternal history of foster care placement, which is strongly associated with maltreatment exposure, was associated with PTB (Bublitz et al., 2014) and a study which showed that the overall Adverse Childhood Experiences scale was associated with PTB (Christiaens, Hegadoren, & Olson, 2015). However, we note important weaknesses in this body of literature. First, except for two studies (Margerison-Zilko et al., 2016; Selk et al., 2016), sample sizes are generally small, and no study has used a national, population based sample. In addition, consideration of vPTB as a separate outcome was considered in only one of these studies (Margerison-Zilko et al., 2016). Further, none of the studies utilized measures of abuse that assessed the relationship between perpetrator and victim and few studies have assessed the impact of non-parents/caregivers specifically as perpetrators. While several studies report associations between exposure to domestic violence in adults and preterm birth, only a limited number of studies have specifically looked at the effects of dating violence experienced by adolescents in relation to subsequent birth outcomes (Madkour, Xie, & Harville, 2013), and these studies do not also include data on family based violence simultaneously. Most studies, with the exception of one (Selk et al., 2016), did not examine effects of timing of child abuse exposure; this study found stronger effects of sexual abuse that occurred before adolescence. Finally, identifying risk factors for preterm delivery within nulliparous populations is challenging since one of the more salient risk factors, previous history of PTB, is not applicable. Only one study has examined the effects of abuse on PTB in nulliparous women (Selk et. al, 2016).

The present study examined exposure to three types of childhood abuse (sexual, physical, verbal) perpetrated by parents/adult caregivers and sexual abuse perpetrated by others in a well-characterized, population based national sample of women with respect to their first liveborn deliveries. The primary objective was to examine associations between maternal exposure to diverse types of child abuse and PTB/vPTB; we hypothesized that abuse and PTB/vPTB would be positively associated.

Methods

Study Population

The National Longitudinal Study of Adolescent to Adult Health (“Add Health”) (Harris et al., 2009) interviewed over 90,000 adolescents in grades 7–12 during 1994–95 in schools located in 80 communities throughout the United States. Sampling methods and stratification ensured that the selected schools were representative of US schools with

respect to region of country, urbanicity, size, school type, and ethnicity. A subset of participants were followed through ages 24–32 in 2008–2009 (Wave IV, n=15,701; response rate=80.3%), when they were queried about history of childhood abuse and provided information on past pregnancies. Inclusion criteria for this analysis were 1) presence of a Wave IV sampling weight (n=14,800), 2) female sex (n=7,870), 3) pregnancy prior to Wave IV which resulted in a live birth (n=4,349), 4) singleton gestation (n=4,229), 5) data on child abuse exposure and length of gestation (n= 4,181). If a woman had given birth more than once, only the first delivery was included. All participants gave their informed consent prior to their inclusion in the study. Secondary analyses were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments and reviewed and approved by the University Institutional Review Board.

Exposure Assessment

History of abuse was assessed via five questions. Three questions asked respondents about parental/adult caregiver sexual, physical, and emotional abuse, and two questions assessed non-parental/adult caregiver sexual abuse motivated by physical and non-physical threats (Harris et al., 2009). Parental/adult caregiver perpetrated abuse was ascertained with these questions: “Before your 18th birthday, how often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved?”, “How often did a parent or adult caregiver hit you with a fist, kick you or throw you down on the floor, into a wall, or down stairs?”, and “How often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations?”. Questions about non-parental/adult caregiver sexual abuse were phrased as, “Have you ever been forced, in a non-physical way, to have any type of sexual activity against your will? For example, through verbal pressure, threats of harm, or by being given alcohol or drugs? Do not include any experiences with a parent or adult caregiver”, and “Have you ever been physically forced to have any type of sexual activity against your will? Do not include any experiences with a parent or adult caregiver”. For each affirmative response, participants were asked about the age abuse first occurred. We defined childhood abuse as beginning when the person was <18 years old.

Abuse subtypes were considered as dichotomous variables and we selected cut points that yield prevalences approximating the Adverse Childhood Experiences questionnaire administered to a multi-state, population based sample (CDC, 2010). For these data, the cutpoints were one or more total times for sexual abuse (both parental/adult caregiver and non-parental/adult caregiver subtypes), two or more times for physical abuse, and three or more times for emotional abuse. These cutpoints are consistent with scoring used in other validated childhood trauma instruments where typically a single experience of sexual abuse is counted as exposure and multiple experiences are necessary to constitute physical and emotional abuse. For analyses that considered age of abuse onset, age at first abuse was divided into quartiles for each individual abuse exposure since existing literature on time periods of vulnerability are limited and the distributions substantially differed for each abuse type. For these data, the 25^{th}, 50^{th}, and 75^{th} percentiles for age of onset were as follows: parental/caregiver emotional abuse: 6.2, 10.0, 13.3 years; physical abuse: 6.1, 9.6, 13.1 years, sexual abuse: 4.4, 7.4, 10.2 years; non-parental/adult caregiver sexual abuse motivated

by non-physical threat: 9.8, 13.6, 15.5 years, and physical force: 8.6, 13.1, 15.3 years, respectively.

Outcome Measures

PTB was defined as delivery of a live born infant at less than 37 weeks gestation and vPTB was defined as less than 34 weeks gestation. The referent group was delivery at 37 weeks or greater for both outcomes. Information on PTB was obtained via participant self-reports at the Wave IV interview. Studies have shown that self-report has good validity when compared to measures of PTB ascertained through medical chart review (Tomeo et al., 1999).

Statistical Analyses

Associations between study characteristics and PTB and vPTB, were examined via chi-square tests. The relationship between maternal exposure to abuse and PTB and vPTB was modeled via logistic regression; separate models were run for PTB and vPTB. In addition to crude models, we ran models adjusted for race and childhood socioeconomic status (highest parental level of education in the household). Information on parental education level was derived from parental report and in the absence of a parent interview, we utilized the participant's report of parental household education. The adjusted model did not include other variables such as smoking because those variables are likely intermediates in the causal pathway between abuse and PTB, rather than true confounders. Models were also stratified according to quartiles of abuse onset as described previously, with no abuse as the referent exposure group in each model. All analyses incorporated complex weighting to account for the survey design using SAS callable SUDAAN. (SUDAAN 11.0.1. Research Triangle Institute, Raleigh, North Carolina; SAS 9.4, SAS Institute, Cary, North Carolina). These weights account for the inverse probability of retention from the baseline study population.

Sensitivity Analyses

Some women reported abuse onset before or within one year of delivery (n for parent/caregiver emotional, physical, and sexual abuse= 45, 20, 4, respectively, and n for non-parent/caregiver sexual abuse motivated by non-physical threats and physical force=8 and 7, respectively). We conducted sensitivity analyses omitting these participants rather than excluding them in our main analyses since recall of timing of abuse is subject to error. We also considered higher frequency cutpoints to define emotional and physical abuse. In another analysis, we stratified results by racial and ethnic categories, given research highlighting the importance of disparities (Kramer et al., 2011). Since vPTB and PTB are competing risks, we also used survival analysis to model proportional hazards. Finally, because recruitment of the study population was contingent on school enrollment and the sample is overrepresentative of high school graduates (85% of Add Health participants in Wave IV report graduating with a diploma, versus 71% of public high school graduates in 1996 in the United States; National Center for Education Statistics), we examined bias related to school enrollment by stratifying on high school completion status.

Results

Table 1 shows descriptive characteristics of this sample. The majority of women were in their late twenties at the time of the Wave IV interview, white, unmarried, had at least a high school degree, and did not smoke during pregnancy. Women reporting a live birth on average had their first delivery in their early twenties. A substantial minority of participants experienced each of the different types of abuse. The prevalences of PTB, vPTB, and abuse were similar to other reports in the literature (Blencowe et al., 2013; CDC, 2010). The prevalence of prenatal smoking is high, as expected, because of the high prevalence of lifetime smoking in the Add Health study population due to the epidemic of teen smoking in the mid-1990s. The mean age at delivery (21.7 years) is younger than the average age of first birth in the United States in 2016, 26.6 years (CDC, 2016).

Table 2 shows the bivariate relationships between study population characteristics and PTB and vPTB. PTB was significantly more common among women who were living with but not married to the baby's father and in women whose highest educational attainment was high school or less (i.e., had no post-secondary education). vPTB was significantly associated with lower levels of parental education.

Table 3 shows the relationship between the different types of abuse and PTB and vPTB. A statistically significant association between sexual abuse perpetrated by non-parents/caregivers by physical force and vPTB was present. This association persisted in models adjusted for race/ethnicity and childhood SES, although the p-value associated with this association was .04, and would not be considered statistically significant when using a Bonferroni correction accounting for multiple comparisons. No other findings were statistically significant and multiple ORs, namely for parent/caregiver abuse in relation to vPTB, were less than 1.

Table 4 shows associations between sexual abuse perpetrated by non-parental/adult caregivers and vPTB, stratifying exposure to abuse according to age of abuse onset, with no abuse exposure as the referent group. Results showed that the effect of sexual abuse perpetrated by non-parental/adult caregivers by physical force was limited to an onset in the 2nd, 3rd, and 4th quartiles of the distribution (ages 9–18). When we combined these categories, abuse that started at these ages was significantly associated with vPTB (aOR=2.32 (95% CI: 1.25, 4.28)). A similar pattern was observed for associations between sexual abuse perpetrated by non-parental/adult caregivers by non-physical threat and vPTB, although the combined OR for the upper 3rd age quartiles did not attain statistical significance (aOR=1.69 (95% CI:0.90, 3.16)). No clear trends for timing for other types of abuse were observed.

Among participants who reported not receiving a high school diploma or a high school equivalency degree by the Wave IV interview, associations between most abuse types and PTB/vPTB were above 1. Effect sizes, particularly for sexual abuse, were also in most cases meaningfully larger in this subgroup than in the overall study population (e.g., in individuals who did not receive a diploma or equivalency degree, parent/caregiver sexual abuse-PTB aOR=2.27 (95% CI: 0.66, 7.75), non-parent/caregiver sexual abuse by verbal threat-PTB

aOR=1.74 (95% CI: (0.68, 4.45), non-parent/caregiver sexual abuse by physical force-PTB aOR= 2.07 (95% CI: 0.76, 5.65)). Due to the small sample size of this subpopulation, however, none of these associations were statistically significant.

Finally, in sensitivity analyses, models that excluded women who reported abuse onset one year before or after delivery yielded results that were very similar to models that did not consider temporality of abuse exposure. Using higher exposure cutpoints to define emotional abuse yielded odds ratios for vPTB that were more towards the null, but still below 1. By contrast, associations between physical abuse and vPTB when using higher cutpoints were further away from the null (i.e., stronger inverse associations) but did not achieve statistical significance. Associations for both exposures with PTB were virtually unchanged with elevated exposure cutoffs. Results stratified on race and ethnicity did not show any consistent pattern of associations. Last, the hazard ratios for PTB were very similar to the ORs from logistic regression models for PTB in our main analyses.

Conclusions for Practice

Overall, associations between maternal exposure to child abuse and PTB and vPTB were mostly null. Only maternal exposure to non-parental/caregiver sexual abuse by physical force was associated with vPTB, suggesting that associations between child abuse and preterm birth may be limited to specific abuse subtypes and specific preterm birth subtypes. Alternatively, this finding may be driven by outliers due to the small number of vPTB deliveries or due to random error, given that we tested multiple exposures and outcomes.

Even though our findings may reflect a chance association, multiple studies report associations between sexual abuse specifically and PTB (Leeners et al., 2010; Margerison-Zilko et al., 2016; Noll et al., 2007; Selk et al., 2016; Stevens-Simons & Reichert, 1994). Further, in studies that examined multiple forms of abuse, sexual abuse appears to be more strongly associated with PTB (Margerison-Zilko et al., 2016; Selk et al., 2016) and important determinants of PTB that are especially linked with vPTB, such as bacterial vaginosis (Cammack et al., 2011). However, unlike these studies, we only found an association with vPTB when considering non-parent/adult caregiver perpetrated abuse by physical force, and did not find an association when we examined exposure to any of the three forms of sexual abuse combined (aOR for exposure to any type of sexual abuse=1.17 (95% CI: 0.71, 1.92)). While we cannot more clearly characterize who constitutes a non-parent/adult caregiver, given that the effect of non-parental/caregiver perpetrated sexual abuse was limited to abuse that occurred in pre-adolescence and adolescence, this exposure may occur largely in the context of dating violence, which has been widely been linked with adverse pregnancy outcomes (Werner et al., 2016). Further, it makes sense that sexual abuse by physical force may be more impactful than abuse by non-physical threats and studies have shown that sexual assault by force is more strongly associated with psychological sequelae than assault by verbal coercion (Brown, Testa, & Messman-Moore, 2009). Also, in this sample, the median age of onset of non-parent/caregiver sexual abuse was substantially later than the median age of parent/caregiver perpetrated sexual abuse. Therefore, non-parent/caregiver sexual abuse may have a more direct impact on pregnancy outcomes if non-parent/caregiver sexual abuse was a more recent exposure that resulted in other harmful

exposures proximal to pregnancy (e.g., post-traumatic stress disorder, sexually transmitted diseases).

The younger age of our study population, relative to most other abuse-PTB study populations that included older women, may play a role in our largely null findings. Specifically, the weathering hypothesis may be relevant (Geronimus, 1992). Studies supporting the weathering hypothesis have shown that in African Americans, the well-established increased risk of PTB (relative to white women) is driven by stronger disparities among older women (Holzman et al., 2009). The persistent effects of and often chronic nature of abuse, particularly parent/caregiver abuse, has similarities to lifecourse stressors experienced by African American women (e.g., socioeconomic stressors and discrimination), which are believed to be the cause of weathering. Hence, it may be possible that effects of abuse, namely parent/caregiver abuse, on birth outcomes are similarly stronger in older women and are therefore not observable in the pregnancy histories collected at the Wave IV interview, when nearly half of the women had not yet reported having a live birth. Unfortunately, since we had few births to women over the age of 30 and none of them were to women of advanced maternal age (maximum age at delivery =33 years), we could not further explore age as a potential effect modifier.

Another possible explanation for these largely null findings lies in the fact that trauma exposure does not necessarily result in negative sequelae, and the Add Health study population may have preferentially selected individuals who were less likely to be adversely affected by abuse. Although the literature focuses on adverse effects of abuse, individuals may be resilient, as has been documented for child abuse in relation to other outcomes (Afifi et al., 2016). Some may also experience post-traumatic growth as a result of trauma exposure (Kaye-Tzadok & Davidson-Arad, 2016) (i.e., positive changes that result from traumatic experiences) which could result in protective effects associated with abuse exposure. While the Add Health study population is nationally representative, it represents abuse survivors who were enrolled in school despite traumatic experiences. In other words, recruitment based on school enrollment may have selected women who were either resilient to trauma (i.e., less likely to experience consequences of abuse such as externalizing and/or internalizing pathology that would have also made them less likely to be enrolled and attending school) and/or experienced post-traumatic growth. Educational achievement and attainment are important components of one frequently utilized conceptualization of resilience, competence (Masten & Obradovic, 2006). Our observation in exploratory analyses that associations between abuse and PTB/vPTB were larger in women who did not graduate high school with a diploma and did not obtain an equivalency degree further supports that a sample with school based recruitment may have yielded a relatively resilient study population. We also note that our results closely mirror findings in the Nurses' Health Study (Selk et al., 2016), another study population that may have favored resilient abuse survivors since all participants attained professional success as nurses, and in that study some abuse types were actually significantly inversely associated with PTB. Finding effects for sexual abuse alone, with non-significant inverse associations for other abuse types is also consistent with another study examining the effect of childhood maltreatment on hypertension within the Add Health study population (Suglia, Clark, Boynton-Jarrett, Kressin, & Koenen, 2014).

This study has several important limitations. First, while the Add Health study population has the advantage of being nationally representative, this population is only representative of individuals who were enrolled in junior high and high school at the time of recruitment and is less generalizable to individuals who dropped out of school, although continuation schools were sampled. Childhood adversity, including abuse, has been linked with school dropout (Porche, Fortuna, Lin, & Alegria, 2011) and therefore, as previously mentioned, the Add Health sample may be disproportionately representative of resilient abuse survivors. Also, Add Health utilizes retrospective recall of abuse history, which may be prone to recall error. While studies of differential recall bias of abuse are limited in the context of perinatal outcomes, studies suggest recall bias is an important consideration with respect to other outcomes (Raphael, Widom, & Lange, 1999). However, differential recall would be expected to induce a positive bias, which is inconsistent with the mostly null and statistically insignificant inverse associations found in this study. Also, a study that examined test-retest reliability in maternal self-reported history of child maltreatment before versus after pregnancy found poor agreement for physical neglect only (Cammack et al., 2016) and a related study also only found evidence of differential recall with respect to pregnancy outcomes for physical neglect (Cammack et al., 2018). Further, in spite of limitations to retrospective self-report, we note that retrospective measures have some advantages over longitudinally collected abuse measures from childhood, such as the lack of threats to validity from fear of consequences of abuse disclosure. These data were also collected in early adulthood, which may have reduced misreporting due to length of time since abuse occurred.

In conclusion, this study offers limited support that maternal exposure to child abuse alone, specifically non-parent/caregiver sexual abuse by physical force, may be associated with vPTB. Due to the small number of vPTB births and multiple abuse types that were examined, these findings should be interpreted with caution. Subsequent studies should more clearly characterize the perpetrator's relationship with the woman. They should also include older women and incorporate measures of resilience that may explain the unexpectedly null associations observed in this study. Given the multifactorial etiology of PTB/vPTB (Esplin, 2014), exposure to child abuse likely acts in concert with other factors to influence the risk of PTB/vPTB. Thus, a multifaceted approach that incorporates other risk factors (e.g., concurrent stressors) and mitigating factors is likely important to understanding the impact of abuse and other adverse childhood experiences on PTB/vPTB and being poised to adopt appropriate preventative measures.

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Significance

What is already known on this subject?

Adverse childhood experiences have been associated with various mental and physical health outcomes, including pregnancy outcomes, and a number of studies suggest that maternal exposure to child abuse may be associated with preterm birth.

What this study adds.

This study showed that only a specific type of sexual abuse was associated with very preterm birth. Mostly null results in a population of young and potentially resilient nulliparous women may also be due to these characteristics acting as effect modifiers that should be further explored, as they have the potential to inform prevention efforts.

Table 1.

Descriptive Characteristics of Analytic Study Population

	Number with Characteristic N[a]	Population Weighted Percent % (95% CI)
Age at First Delivery	4,181	Mean=21.7 years (21.1, 22.3)
Age at Time of Wave IV Interview	4,181	Mean=29.0 years (29.2, 29.8)
Parental/Adult Caregiver Abuse		
Emotional Abuse[b]	1,325	34.3 (32.2, 36.4)
Physical Abuse[c]	596	15.0 (13.6, 16.6)
Sexual Abuse[d]	355	8.8 (7.5, 10.2)
Non-Parental/Adult Caregiver Sexual Abuse		
Motivated by Non-Physical Threat[e]	555	15.1 (13.6, 16.7)
Motivated by Physical Force[f]	411	11.0 (9.8, 12.4)
Preterm Birth (<37 weeks of gestation)	426	10.3 (9.1, 11.6)
Very Preterm Birth (<34 weeks of gestation)	139	3.3 (2.7, 4.1)
Race/Ethnicity		
Hispanic	691	12.1 (8.7, 16.5)
Black	1,017	18.2 (13.8, 23.6)
Other	291	5.1 (3.8, 7.0)
White	2,179	64.6 (58.2, 70.6)
Childhood SES (Highest Household Education Level)		
Less than High School	659	14.7 (11.9, 18.)
High School or GED	1,242	32.7 (30.2, 35.4) 31.2 (29, 33.6)
Some College	1,236	
College Degree +	959	21.3 (18.8, 24.1)
Adult Income		
<40,000 per year	1,533	40.5 (37.3, 43.9)
=>40,000 per year	2,420	59.5 (56.2, 62.7)
Marital Status During Pregnancy		
Not Married, Not Cohabiting	1,674	41.4 (37.5, 45.5)
Cohabiting	1,062	25.3 (23.0, 27.9)
Married	1,444	33.3 (30.3, 36.4)
High School Completion Status at Wave IV		
No GED, Certificate of Completion, or Diploma	298	8.7 (7.1, 10.5)
GED or Certificate of Completion	413	11.2 (9.7, 12.9)
Diploma	3,470	80.1 (77.4, 82.6)
Highest Level Education at Wave IV		
No Post-Secondary Education	1,061	27.4 (24.9, 30.1)
At Least Some Post-Secondary Education	3,120	72.6 (69.9, 75.2)
Smoking During Pregnancy		

	Number with Characteristic	Population Weighted Percent
	N[a]	% (95% CI)
Yes	744	21.1 (18.3, 24.2)
No	3,426	78.9 (75.8, 81.7)

[a]Numbers may total to less than 4181 due to missing data.

[b]Missing data for 37 participants

[c]Missing data for 28 participants

[d]Missing data for 25 participants

[e]Missing data for 25 participants

[f]Missing data for 11 participants

Table 2.

Distribution of Study Population Characteristics, Stratified by Preterm Status

	Weighted Percent of Those with Characteristic Delivering ≥ 37 Weeks % (95% CI)	Weighted Percent of Those with Characteristic Delivering <37 Weeks % (95% CI)	Weighted Percent of Those with Characteristic Delivering ≥34 Weeks % (95% CI)	Weighted Percent of Those with Characteristic Delivering <34 Weeks % (95% CI)
Age at Delivery				
<20 years old at delivery	89.9 (87.5, 91.8)	10.1 (8.2, 12.5)	96.7 (95.1, 97.8)	3.3 (2.2, 4.3)
≥20 years old at delivery	89.6 (87.8, 91.2)	10.4 (8.9, 12.1)	96.7 (95.7, 97.4)	3.3 (2.6, 4.3)
Race				
Hispanic	89.0 (85.9, 91.5)	11.0 (8.5, 14.2)	95.8 (93.8, 97.1)	4.2 (2.9, 6.1)
Black	89.2 (86.5, 91.5)	10.8 (8.6, 13.5)	95.5 (93.5, 96.9)	4.5 (3.1, 6.5)
Other	92.3 (85.6, 96.0)	7.8 (4.0, 14.4)	95.7 (90.4, 98.2)	4.3 (1.9, 9.6)
White	89.8 (88.2, 91.1)	10.2 (8.9, 11.8)	97.2 (96.3, 98.0)	2.8 (2.1, 3.7)
Highest Childhood Household Education Level[a]				
Less Than High School	89.1 (86.1, 91.5)	10.9 (8.5, 13.9)	96.0 (93.7, 97.4)	4.0 (2.6, 6.3)
High School or GED	88.4 (85.5, 90.2)	11.6 (9.3, 14.5)	95.9 (94.4, 97.1)	4.0 (2.9, 5.6)
Some College	90.2 (87.7, 92.2)	9.8 (7.8, 12.3)	96.8 (95.1, 97.2)	3.2 (2.1, 4.9)
College Degree +	91.0 (88.7, 92.9)	9.0 (7.0, 11.3)	97.9 (96.5, 98.7)	2.1 (1.3, 3.5)
Marital Status During Pregnancy[b]				
Not Married, Not Cohabiting	89.7 (87.6, 91.5)	10.3 (8.5, 12.4)	96.9 (95.6, 97.8)	3.1 (2.2, 4.4)
Cohabiting	87.1 (84.1, 89.6)	12.9 (10.4, 15.9)	95.7 (94.1, 96.9)	4.3 (3.2, 5.9)
Married	91.7 (89.6, 93.4)	8.3 (6.6, 10.4)	97.1 (95.8, 98.0)	2.9 (2.0, 4.2)
High School Completion Status at Wave IV				
No GED, Certificate of Completion, or Diploma	87.6 (82.4, 91.4)	12.4 (8.6, 17.6)	96.9 (92.8, 98.7)	3.1 (1.3, 7.2)
GED or Certificate of Completion	91.9 (87.8, 94.8)	8.1 (5.3, 12.2)	96.4 (93.3, 98.1)	3.6 (1.9, 6.7)
Diploma	89.6 (88.1, 91.0)	10.4 (9.1, 11.9)	96.7 (95.9, 97.4)	3.3 (2.6, 4.2)
Highest Level of Education at Wave IV[b]				
No Post-Secondary Education	86.5 (83.6, 89.0)	13.5 (11.0, 16.4)	95.6 (93.8, 96.7)	4.4 (3.2, 6.2)
At Least Some PostSecondary Education	90.9 (89.7, 92.0)	9.1 (8.0, 10.3)	97.1 (96.2, 97.7)	2.9 (2.3, 3.7)
Smoking During Pregnancy				
Yes	90.6 (87.5, 92.9)	9.4 (7.1, 12.5)	97.7 (96.3, 98.6)	2.3 (1.4, 3.7)
No	89.5 (88.0, 90.9)	10.5 (9.1, 12.0)	96.4 (95.5, 97.2)	3.6 (2.8, 4.5)

[a]Chi-Square p <.05 for vPTB

[b] Chi-Square p<.05 for PTB

Table 3.

Overall Associations Between Child Abuse and Preterm/Very Preterm Birth

		PTB (<37 weeks)				vPTB (<34 weeks)			
		Term N[a]	PTB N[b]	Crude Associations Weighted OR (95% CI)	Adjusted for Race and Childhood SES Weighted OR (95% CI)	Term N	vPTB N[c]	Crude Associations Weighted OR (95% CI)	Adjusted for Race and Childhood SES Weighted OR (95% CI)
Parental/Adult Caregiver Abuse									
	Exposed	1,194	131	0.93 (0.69, 1.24)	0.97 (0.72, 1.31)	1,194	39	0.65 (0.40, 1.07)	0.71 (0.43,1.17)
Emotional Abuse	Unexposed	2,525	294			2,525	99		
	Exposed	534	62	1.13 (0.79, 1.63)	1.19 (0.83, 1.71)	534	19	0.95 (0.55, 1.63)	1.00 (0.58, 1.72)
Physical Abuse	Unexposed	3,194	363			3,194	120		
	Exposed	319	36	0.92 (0.62, 1.37)	0.88 (0.58, 1.35)	319	11	0.81 (0.42, 1.55)	0.81 (0.42, 1.56)
Sexual Abuse	Unexposed	3,412	389			3,412	128		
Non-Parental/Adult Caregiver Abuse									
	Exposed	498	57	1.07 (0.76, 1.51)	1.10 (0.78, 1.56)	498	21	1.34 (0.76, 2.34)	1.43 (0.82, 2.50)
Sexual Abuse Motivated by Non-Physical Threat	Unexposed	3,245	367			3,245	118		
	Exposed	368	43	0.99 (0.68, 1.44)	1.03 (0.70, 1.50)	368	20	1.83 (1.04, 3.20)	1.94 (1.10, 3.44)
Sexual Abuse Motivated by Physical Force	Unexposed	3,377	382			3,377	119		
Abuse Sum (continuous)				1.00 (0.95, 1.07)	1.02 (0.90, 1.12)			1.01 (0.85, 1.18)	1.04 (0.89, 1.21)

[a] Number of term deliveries may not sum to 3,755 due to missing data

[b] Number of PTB deliveries may not sum to 426 due to missing data

[c] Number of vPTB deliveries may to sum to 139 due to missing data

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Table 4.

Associations Between Non-Parent/Caregiver Sexual Abuse and Very Preterm Birth, Stratified by Quartile of Age of Abuse Onset

		1st Quartile (ages 0–9)			2nd Quartile (ages 9–14)			3rd Quartile (ages 14–16)			4th Quartile (ages 16–18)		
		Term N	vPTB N	Weighted aOR (95% CI)	Term N	vPTB N	Weighted aOR (95% CI)	Term N	vPTB N	Weighted aOR (95% CI)	Term N	vPTB N	Weighted aOR (95% CI)
Sexual Abuse Motivated by Non-Physical Threat	Exposed	132	5	0.65 (0.21, 2.07)	91	5	2.11 (0.73, 6.08)	122	5	1.42 (0.53, 3.82)	153	6	1.66 (0.70, 3.92)
	Unexposed	3,133	116		3,133	116		3,133	116		3,133	116	
Sexual Abuse Motivated by Physical Force	Exposed	86	3	0.75 (0.20, 2.79)	94	6	2.50 (0.93, 6.69)	85	5	2.17 (0.74, 6.35)	103	6	2.27 (0.90, 5.71)
	Unexposed	3,307	118		3,307	118		3,307	118		3,307	118	

[a] Adjusted for Race and Childhood Socioeconomic Status