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Child Abuse and Neglect, Preterm Birth, and Associated Mediators

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Child Abuse and Neglect, Preterm Birth, and Associated Mediators

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An abstract of
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Abstract

Child Abuse and Neglect, Preterm Birth, and Associated Mediators
By Alison Leigh Cammack

Psychosocial stress has emerged as an important risk factor for preterm birth, but maternal exposure to child abuse and neglect remain understudied with respect to preterm birth and associated mediators. In the context of perinatal outcomes, maltreatment is typically measured via retrospective self-report, which may be prone to measurement error and selective recall. The goals of this dissertation were to explore bias in reporting of history of child maltreatment around the time of pregnancy and to understand links between maltreatment, preterm birth, and smoking, a common and modifiable risk factor for preterm birth.

Using original data from the Emory Women's Mental Health Program, history of childhood maltreatment was measured before and after delivery for each woman, using the Childhood Trauma Questionnaire. Overall test-retest reliability was at least moderate for all trauma types except physical neglect. However, for those experiencing certain adverse pregnancy outcomes, there was a tendency to report trauma after delivery but not before. Further, associations of physical neglect with low birth weight and preterm birth indicated an inverse relationship when neglect was measured before delivery and a positive relationship when measured after delivery.

In the National Longitudinal Study of Adolescent to Adult Health, non-parental/caregiver sexual abuse by physical force was associated with very preterm birth. This association was limited to women whose abuse started after age nine. Non-parental/caregiver sexual abuse by physical force was also associated with continued smoking into pregnancy among women with a history of regular smoking. When stratified by depressive symptoms, associations of physical abuse and non-parental/caregiver sexual abuse with continued smoking were limited to women with depressive symptomatology, and depressive symptoms significantly modified the effect of parental/caregiver sexual and physical abuse.

This dissertation shows that maternal exposure to abuse, particularly sexual abuse, is associated with early preterm birth and is a determinant of modifiable behaviors in pregnant women. It also shows that misclassification and recall bias may be present for specific forms of maltreatment, namely physical neglect. These findings suggest that future research into effective screening and interventions involving clinic populations, including well-woman, prenatal, and postpartum care, may be important.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction and Motivation

Identifying determinants of perinatal outcomes is an important, yet challenging public health problem due to the lifelong impact on affected individuals. One specific outcome, which constitutes the primary focus of this dissertation, is preterm birth (PTB), defined as the live birth of an infant at less than 37 completed weeks of gestation. This chapter introduces the problem of preterm birth, summarizes the literature and limitations of studies related to psychosocial stressors and preterm birth, outlines the dissertation aims, and discusses the scientific, public health, and criminal justice importance of studies addressing the dissertation aims.

Descriptive Epidemiology and Public Health Significance of Preterm Birth

Preterm birth is a highly prevalent public health problem, particularly in the United States. In the United States during 2014, the prevalence of preterm birth was 9.57% (CDC). In Europe and other developed countries, the prevalence of preterm birth is 5–9% (Goldenberg, 2008).

Preterm birth is a heterogeneous outcome which can be further categorized according to gestational age. About 5% of preterm births occur at less than 28 weeks of gestation, about 15% at 28–31 weeks, 20% at 32–33 weeks, and 60–70% at 34–36 weeks of gestation (Goldenberg, 2008). Although both early preterm birth and near term births may have diverse etiologies, certain etiologies, such as infection, may be more clearly

associated with preterm birth at certain gestational ages.   Preterm birth can arise spontaneously or can be medically indicated.

Preterm birth is also a salient public health problem, as it has been associated with multiple subsequent adverse physical, mental and behavioral health outcomes throughout the lifespan and is associated with healthcare costs of $12.7 billion annually (March of Dimes, 2014). Beginning with early life sequelae, preterm birth is the leading cause of infant morbidity and mortality in the United States, despite advances in neonatal intensive care (Callaghan, 2006). Moreover, preterm infants have an elevated risk of a variety of different neonatal conditions, including respiratory distress syndrome, intraventricular hemorrhage, life threatening infections (e.g., necrotizing enterocolitis), cerebral palsy, apnea, hypoglycemia, seizures, jaundice, and feeding problems (Larroque, 2008). Later in life, infants born prior to term are also at risk of developmental disorders, such as intellectual disability, attention deficit disorder, and other schooling difficulties (Aarnoudse-Moens, 2009; Anderson, 2014; Bhutta, 2002; Marret, 2009).   Although the risk of these outcomes is generally higher in early preterm infants, findings also suggest that these outcomes are elevated among infants born near term (Kramer, 2000).

Preterm birth is also linked with health outcomes in adulthood. A large body of literature, including human epidemiologic studies, as well as animal experimental studies, suggests that exposures before and shortly after birth can influence outcomes decades later as a result of physiological programming (Gluckman, 2008).   In recent years, a variety of prenatal exposures, such as fetal growth restriction (Barker, 1993), severe stressors around the time of pregnancy (Class, 2014; Malaspina, 2008; Watson, 1999), and toxicant exposure (Ng, 2007; O'Reilly, 2010; Small, 2011) also have been related to

health sequelae in the offspring several decades later. Specifically with respect to PTB, studies suggest an independent relationship between PTB and various distant health outcomes among offspring, including risk factors for cardiovascular disease (Bayman, 2014; Bertagnolli, 2016; Dalziel, 2007) cancer (Kaijser, 2005), impaired reproductive capacity (Swamy, 2008), and impaired social functioning (Lindstrom, 2007; Weisglas-Kuperus, 2009). Thus, PTB may be an important determinant of multiple near and distant health outcomes.

Prediction of Preterm Birth, the Role of Psychosocial Stress, and Key Literature Gaps

Preterm birth is a complex condition with multifactorial etiology. Nevertheless, a number of risk factors have been identified for PTB. These consist of non-modifiable risk factors such as previous history of PTB (2-10 fold increased risk; Bloom, 2001; Kazemier, 2014; Mercer, 1999), specific anatomical factors (e.g., incompetent cervix; Vink, 2016), and multiple gestation pregnancy (Goldenberg, 2008). These also include potentially modifiable risk factors, including substance use (e.g., illegal drugs) (Black, 2013; Creanga, 2012; Gorman, 2014), low socioeconomic status (Blumenshine, 2010; Collins, 2015; Gray, 2014; Huynh, 2014), extremes of body mass index (Bhattacharya, 2007; Marchi, 2015; Zhong, 2010), infections (Romero, 2001), and short interconception intervals between pregnancies (Hogue, 2011; Wendt, 2012). African American race is associated with a 3-4 fold risk compared to non-Hispanic whites (Goldenberg, 2008; Kramer, 2009; Shaaf, 2013), but whether this is a modifiable or non-modifiable risk

depends on underlying etiologies, most of which have not been identified. Maternal infection, for example, may confound the race/PTB association and be amenable to intervention.

However, despite the knowledge of these risk factors, prediction of preterm birth remains a challenge. In general, risk schemes tend to have low sensitivity and only identify a fraction, typically less than half, of women who deliver preterm infants (Mercer, 1996; Vogel, 2005), particularly among asymptomatic women, and risk schemes have not been tested through clinical trials (Davey, 2015). Specificities are somewhat better (e.g., 60-65% for risk schemes involving cervical length; Vogel, 2005), but while this can give some women assurance, it is not helpful in pinpointing which high risk women will deliver preterm. Interventions for preterm birth have only shown limited success. For example, while interventions such as progesterone supplementation have shown some success in preventing recurrent preterm birth, most interventions to reduce preterm birth in the broader population of pregnant women have not yielded consistent results in clinical trials (Iams, 2008; Caritis, 2016). Hence, the pursuit of additional risk factors for PTB, particularly those which may be related to it through multiple biologically plausible pathways, and a clearer understanding of how those risk factors may lead to preterm birth, remain public health priorities.

As will be further discussed in chapter 2, psychosocial stress has received considerable attention as a risk factor for preterm birth. Consistent with broader definitions of stress (e.g., Selye's (1956) definition of "the body's nonspecific response to a demand placed on it" vs. Lazarus's 1966 definition that "stress occurs when an individual *perceives* that the demands of an external situation are beyond his or her

perceived ability to cope with them"), studies have conceptualized stress in a variety of ways, including objective measures of stressors, such as recent life events, as well as perceptions of stress. Many studies report consistent, but small associations between these various forms of psychosocial stress and PTB (Dole, 2003; Nordentoft, 1996; Shapiro, 2013 Wadhwa, 1993). Also, a large body of literature has established that psychosocial stress is associated with multiple biological and behavioral mediators of PTB, such as dysregulation of the hypothalamic pituitary adrenal (HPA) axis, infection, and substance abuse. Further, there is evidence that stressors occurring before pregnancy (de Weerth, 2005) and those of a chronic nature (McEwen, 1998) may exert different and relatively stronger effects as compared to acute stressors. However, fewer studies of the relationship between psychosocial stress and PTB have explicitly considered stressors occurring before pregnancy and those of a chronic nature.

One class of common, chronic early life stressors that has received relatively little attention with respect to perinatal outcomes is adverse childhood experiences, namely abuse and neglect. In the Adverse Childhood Experiences Study, 24.7, 29.0, 13.1, 9.2, and 16.7 percent of women reported exposure to sexual abuse, physical abuse, emotional abuse, physical neglect, and emotional abuse, respectively, before age 18 (Felitti, 1998). As will also be further discussed in chapter 2, a substantial literature has linked child abuse and neglect with "upstream" psychopathology and maladaptive coping mechanisms (e.g., smoking) during preconception and pregnancy, which in turn may affect "downstream" physiological factors during pregnancy, such as regulation of the hypothalamic-pituitary-adrenal axis (HPA). Two theoretical frameworks also support a relationship between child abuse and neglect and distant adult health outcomes. These

include the fetal origins hypothesis, as previously described, as well as the weathering

hypothesis/allostatic load, which posits that physiological changes due to chronic stress

exposure (such as child abuse/neglect) lead to cumulative wear and tear on physiological

responses to stress, thereby affecting health outcomes (Geronimus, 1996; Holzman,

2009).

However, despite the plausibility of a relationship between childhood trauma and

preterm birth, only a relatively small number of studies yielding mixed results have

examined the relationship between childhood trauma and PTB (Benedict, 1999;

Grimstad, 1999; Leeners, 2010; Noll, 2007a; Margerison-Zilk, 2016; Selk, 2016;

Stevens-Simon, 1993).   These studies suffer from important gaps which compromise the

ability to draw conclusions.   Also, it remains unclear whether common sequelae of abuse

are as common among pregnant women, since women adapt their behaviors in response

to pregnancy, responses to stressors are generally dampened during pregnancy (Glynn,

2001; Ross, 2002), and severe stressors can interfere with the ability to become pregnant

(Jacobs, 2015; Hjollund, 1999). Further, studies that explain possible mechanisms

through which child maltreatment may be linked to preterm birth are limited in that they

often fail to quantify changes in modifiable behaviors. Finally, the literature pertaining to

the reliability of retrospective reporting of these exposures, particularly around the time

of pregnancy, and predictors of reliability is limited, introducing the possibility of

exposure misclassification. More worrisome, some studies from the non-pregnancy

literature provide evidence that supports the hypothesis that the relationship between

childhood maltreatment and adult outcomes may be driven by recall bias (Widom, 1999).

Therefore, there is a need to further explore the relationship between childhood

maltreatment and PTB, and behaviors that put one at risk for PTB, and refine our understanding of the potential for bias in any reported child abuse/neglect-PTB associations.

Dissertation Aims

To address the above mentioned research gaps, this dissertation has the following three research aims.   Aim 1 will help inform misclassification of measurement of childhood abuse and neglect via retrospective self-report, specifically around the time of pregnancy, by evaluating 1) overall test-retest-reliability in a sample of preconception/pregnant/postpartum women and 2) perinatal outcomes as a determinant of reliability and whether assessment of childhood maltreatment before versus after delivery influences associations between child maltreatment and perinatal outcomes. Aim 2 will evaluate the association between self-reported maternal exposure to childhood abuse (sexual, physical, verbal) perpetrated by parents/adult caregivers and sexual abuse perpetrated by others with self-reported exposure of preterm birth and very preterm birth (vPTB) in a nationally representative, population-based sample. Finally, Aim 3 will evaluate the association between self-reported maternal exposure to childhood abuse (sexual, physical, verbal) perpetrated by parents/adult caregivers and sexual abuse perpetrated by others with behavioral and cessation of maladaptive behavior during pregnancy, using smoking as a model behavior.

Aim 1 is the first study, using any instrument, to examine self-reported retrospective test reliability of child maltreatment around the time of pregnancy.   It is

also the first study to examine whether pregnancy outcomes may affect reporting of childhood trauma. Regarding Aim 2, this is the first nationally representative population-based study to examine the relationship between abuse and preterm birth and the first to distinguish abuse by perpetrator type. Aim 3 is the first to study smoking discontinuation specifically with respect to pregnancy, rather than smoking cross-sectionally measured smoking.

Scientific, Public Health, and Criminal Justice Implications

Results from these analyses have the potential to make important contributions to scientific and public health knowledge. First, as previously explained, an assessment of the impact of child abuse and neglect will help clarify the relationship between psychosocial stress and perinatal outcomes. Moreover, there is considerable interest in early life adversity, and how it relates to perinatal outcomes (e.g., Kramer, 2011). These studies will further contribute to this growing body of literature.

Second, the identification of relationships between abuse and potential mediators of preterm birth such as smoking into pregnancy may inform mechanistic pathways, which may aid in the elucidation of the pathophysiology and understanding of how risk factors for PTB translate into increased risk. Notably, prevention strategies aimed at such intermediates may offer alternate vantage points for intervention. Identifying vulnerable individuals who may most clearly benefit from such interventions may translate to their increased effectiveness.

Third, studies of the childhood abuse and neglect-PTB relationship may inform health disparities research. Racial disparities persist for birth outcomes such as PTB,

even when accounting for socioeconomic factors. Life course stressors with roots in childhood have specifically been posited to explain residual variance (Hogue, 2005; Lu, 2003; Rich-Edwards, 2005). Resolving racial disparities in perinatal outcomes remains a public health priority; hence a better understanding of stress models may be informative to minority populations.

These studies may also have important implications in improving knowledge about and interventions related to child maltreatment. First, these studies may call attention to screening and secondary interventions to diminish the impact of child abuse and neglect. Since the majority of victims are not identified by the criminal justice system, screening is a critical first step to identifying affected individuals; routine prenatal care represents a prime opportunity to identify large numbers of women. Among obstetricians and gynecologists, there is increasing recognition that childhood trauma is a common exposure that may have adult manifestations, although much of this recognition is limited to sexual abuse. The American College of Obstetricians and Gynecologists advocates screening for a lifetime history of sexual abuse (ACOG, 2011), although formal recommendations regarding timing and frequency of screening are not in place. Thus, evidence of an association between childhood trauma and adverse pregnancy outcomes may further guide such recommendations and expand them to additional childhood exposures.

Finally, results from this study may also inform mechanisms of intergenerational transfer of abuse (Galler, 2014; Thornbery, 2012). Studies have reported that children born preterm are at higher risk of abuse and neglect (e.g., Spencer, 2006) Thus, in addition to other proposed pathways of intergenerational transfer (e.g., parenting

practices; Serbin, 2004), these findings may be used to design and implement additional interventions to halt the transfer, as current strategies show limited effectiveness (Reynolds, 2009). Interventions targeted to women while they are pregnant may be advantageous, as identifying children at risk before birth provides maximal opportunities to intervene. Thus, studies of the relationships between child abuse and neglect, preterm birth, and associated mediators are broadly applicable to public health and criminal justice communities.

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CHAPTER 2

Literature Review

The first half of this chapter further expands on the exposures of childhood abuse and neglect (definitions, descriptive epidemiology, and issues pertaining to measurement bias). The second half of this chapter reviews the literature relevant to associations between childhood abuse, preterm birth, and potential mediators of these associations.

CHILDHOOD ABUSE AND NEGLECT LITERATURE REVIEW

Definitions of Childhood Maltreatment

Childhood maltreatment encompasses actions of commission (i.e., abuse) and omission (i.e., neglect) (CDC, 2011). These exposures can be considered a subset of adverse childhood experiences, which include a broad range of exposures (e.g., parental deaths, divorce). Various definitions exist for childhood abuse and neglect subtypes and in general, universal definitions are not applied, hence various scales exist to measure these exposures. Some measures, such as the Childhood Trauma Questionnaire (CTQ) (Bernstein, 2003) capture the chronicity of exposures, whereas other measures (e.g., Adverse Childhood Experiences Questionnaire; Felitti; 1998) consist of a series of yes/no questions to specific acts. Inconsistency in definitions makes it difficult to assess validity of maltreatment.

In general, neglect is conceptualized as omissions by a parent/caregiver that lead to lack of adequate care for a child (English, 2005), although some investigators believe that neglect should be defined by a child's experiences of unmet needs, rather than by parental behavior (Dubowitz, 1993). Examples include failure to provide adequate health care, education, or supervision; lack of protection from environmental hazards; not meeting physical needs (e.g., clothing or food); and lack of emotional support, resulting in actual or potential harm (Dubowitz, 2007). As reflected in the above examples, neglect encompasses physical and emotional needs.

In contrast to neglect, abuse generally reflects words or overt actions that cause harm, potential harm, or threat of harm to a child, and are deliberate and intentional (CDC, 2008). Regarding childhood sexual abuse (CSA), a key aspect is that it involves a perpetrator in a dominant position who forces or coerces a child into sexual activity (APA, 2011). Child sexual abuse may include contact abuse (e.g., fondling, oral-genital contact, digital penetration, and vaginal and anal intercourse), and some researchers also include non-contact abuse, (e.g., voyeurism, and child pornography) in the definition of sexual abuse (APA, 2011). Physical abuse by parents or caregivers includes beatings, shaking, scalding, and biting (Dubowitz, 2007). Some include corporal punishment in this definition, although the appropriateness of this has been debated (Dubowitz, 2007). According to O'Hagan (1995), emotional abuse is the sustained, repetitive, inappropriate emotional response to the child's experience of emotion and its accompanying expressive behavior. O'Hagan further distinguishes psychological abuse from emotional abuse (a distinction not shared by all researchers) as the sustained, repetitive, inappropriate behavior which damages or substantially reduces the creative and developmental

potential of crucially important mental faculties and mental processes of a child (e.g., domestic violence, desertion, unpredictability, lies, deception, and exploitation). Verbal abuse is often viewed as a subset of emotional abuse.

Although abuse is frequently defined as being perpetrated by a family member or caregiver, many people can act as perpetrators of child abuse. The literature often distinguishes between intrafamilial and extrafamilial inflicted abuse. Intrafamilial abuse can be perpetrated by the parents, or other adults (e.g., uncles), but it is also important to note that children within families also are perpetrators of abuse, particularly sexual abuse. One study reported that sibling abuse is five times more common than abuse perpetrated by stepfathers and fathers (Finklehor, 1980). Children and adults outside of the family can also serve as perpetrators of abuse, particularly when dating violence among adolescents is considered. In the United States, data from the Youth Behavior Survey (CDC, 2014) showed that 13% of girls experienced physical dating violence, and 14.4% experienced sexual dating violence. A report from the World Health Organization (WHO, 2013) of 81 countries yielded similar findings, reporting a prevalence of physical and/or sexual IPV among ever-partnered 15-19 year old girls of 29.4%.

Epidemiology of Child Maltreatment

In general, self-reported estimates of childhood abuse and neglect can differ considerably due to varying definitions and populations utilized. Population based samples include the Behavioral Risk Factor Surveillance System (BRFSS), which reported prevalences of 26.9%, 15.4%, and 17.2%, for childhood verbal abuse, physical

abuse, and sexual abuse, respectively, in women in five states in the US (MMWR, 2010).

For CSA, the prevalence varies considerably among studies, ranging from 3 to 62%, and

among women, a meta-analysis found an overall prevalence of 22.3%, and estimated

prevalences of 16.8% and 14.8% for all forms of sexual abuse and contact abuse,

respectively, after accounting for reporting biases (Gorey, 1997).   A more recent meta-

analysis reported similar figures (18%; Stoltenborgh, 2011).   CSA prevalence is

particularly variable since there is considerable variability in definitions utilized.   For

physical abuse, a random sample of adults in the United States reported a prevalence of

19.5% in women (Briere, 2003) and other population-based studies have reported similar

prevalences (MacMillan, 1997; Stoltenborgh, 2013). Last, a meta-analysis of neglect,

which is less commonly measured than abuse, yielded prevalences of 16.3% and 18.4%

for emotional and physical abuse, respectively (Stoltenborgh, 2013), underscoring that

neglect is a form of maltreatment with a similar prevalence to abuse.

It is generally believed that the true prevalence of abuse and neglect is higher than

self-report, as factors including fear and social and/or family dynamics may prevent

disclosure (Kogan, 2004).   Although self-report is believed to represent an

underestimate, prevalences based on registry-derived reporting (e.g., Child Protective

Services; CPS) are even lower than those of self- report (MacMillan, 2003).   In 2014, the

Administration on Children Youth and Families reported that among American children,

4.3% of children were reported to CPS and after investigations were conducted, 0.9% of

children were confirmed victims of maltreatment.   Further, there is evidence of

differential reporting; some studies have found that low socioeconomic status and

African-American race are associated with a higher likelihood of reporting an abusive

event to authorities (Hampton, 1985; MacMillan; 2003). Some propose that this difference may be related to true demographic differences in abuse rather than a reporting difference, but some studies have also noted racial biases in reporting (Detlaff, 2011).

Both retrospective self-report and longitudinal, prospective methods are important measures of self-reported childhood maltreatment history. Retrospective self-report is particularly convenient to use in epidemiologic studies that look at distant outcomes. However, it has important limitations, particularly those pertaining to recall related internal validity. Some studies have found that a substantial percentage of individuals with documented abuse may not recall abuse as adults (Widom, 1996; Widom, 1997), although this is not a consistently observed finding (Kendall-Tackett, 2004). However, maltreatment measured from longitudinal, prospective studies also has important limitations, and it is important to note that neither measure serves as a gold standard measure. Even though longitudinal studies have some advantages in terms of recall, they may have compromised internal validity because required reporting may affect willingness to disclose abuse (Amaya-Jackson, 2000). Also, longitudinal studies often utilize at-risk populations and substantiated abuse underestimates the number of truly exposed individuals, and identified children may systematically differ from the overall population of individuals exposed to maltreatment (Gilbert, 2009). Thus, retrospective self-report has distinct advantages, compared to other measures of childhood maltreatment.

Several risk factors are associated with abuse and neglect. Regarding demographic factors, some studies reported that white race is associated with histories of emotional abuse and neglect and black racial background is associated with physical

neglect (Scher, 2004; MMWR, 2010).   However, it is important to note that some

literature suggests that racial differences may not be true differences and may be more

reflective of cultural perceptions of abuse (Thombs, 2007). Low socioeconomic status

has also been associated with multiple forms of abuse and neglect (Gilbert, 2009; CDC,

2016; Eckenrode, 2014). However, demographic risk factors appear to be less important

for CSA. A relationship between low socioeconomic status (SES) and CSA has been

noted in registry based data and in some (Priebe, 2009; MacMillan, 2013) but not all

population-based surveys (Finkelhor, 1994).   Associations between race/ethnicity and

CSA are generally weak, although some more recent studies report associations

(MMWR, 2010). Household structure, particularly the presence of a stepfather, has been

frequently associated with CSA (Finkelhor, 1993; Mullen, 1996).   Among those

experiencing maltreatment, multiple episodes of abuse and neglect are common. For

example, over half of female CSA victims experience multiple episodes and chronic

violations may be more strongly linked to subsequent psychopathology (Kendall-Tacket,

1993; Molnar, 2001).

Reliability of Childhood Trauma and Adverse Childhood Experiences

Misclassification of childhood maltreatment is a concern due to the taboo nature

of the subject. Due to the lack of a clear gold standard measure, validity studies are

difficult to conduct. However, other approaches to studying misclassification, while not

as optimal, may still be useful. One such approach considers test-retest reliability.   Good

reliability cannot guarantee validity, but poor reliability indicates the presence of poor validity.

Some studies of test-retest reliability of childhood trauma suggest that it has acceptable to good reliability. For example, the Adverse Childhood Experiences study questionnaire reports Kappa values ranging from .52 to .75 (Dube, 2004). However, other studies suggest less optimal reliability. A New Zealand birth cohort that examined test-retest reliability of childhood sexual and physical abuse at ages 18 and 21 reported kappas of .47 and .45, respectively (Fergusson, 2000) and Da Silva (2012) reported Kappas ranging from .33 to .43 for various domains of maltreatment on the Childhood History Questionnaire. The CTQ has also been assessed with respect to test-retest reliability. Most studies have reported relatively good reliability on the five subscales of sexual abuse, physical abuse, emotional abuse, physical neglect, and emotional neglect (intraclass correlations >.85) (Bernstein, 1994; Bernstein, 1997; Paivio, 2004). However, these studies have been limited by relatively short test-retest intervals (<6 months). Also, a significant number of these studies utilize clinical samples (e.g., Bernstein, 1994; Bernstein, 1997).

Various factors have been proposed to explain suboptimal reliability of retrospective reporting of childhood trauma. The first of these factors is mood state. There are experimental studies that induction of depressive or negative moods can encourage recall of unhappy memories (Bower, 1981; Singer, 1988). However, evidence from other studies is conflicting. In an observational study, Fergusson (2000) found no association between psychiatric state and ability to recall sexual or physical abuse. Some studies suggest that the effect of mood may not be strong. For example, an experimental

study specifically examined recall of childhood memories vs. recent memories, depressive mood induction affected recall of recent events, but had no effect on distant memories (Salovey, 1989).

Second, limitations of memory may influence the validity and reliability of distant retrospective recall.   Memory may be influenced by biological factors, including endocrine factors. Glucocorticoids, estrogen, and their associated receptors have been shown to influence episodic memory and cognition (Engler-Chiurazzi, 2016; Kino, 2015). Also, most adults have few memories during the first two years of life for both "normal" and unusual events, calling into question the accuracy of such memories during adulthood (Hardt, 2004). A recent study (Cammack, 2017) showed that many adults reported abuse during very early childhood (e.g., more than 25% reported sexual abuse before the age of primary school entry). Although these early reports of maltreatment could be in part due to recall error, these reports should not be discredited.

Third, time between assessments of adverse childhood experiences may also be important. Few studies have compared multiple time periods, although assessments of the Parental Bonding Inventory, which measures styles of parenting, have shown decreases in reliability over time (e.g., 10 year test-retest vs. 6 month test retest; Wilhelm, 1990). As noted by Hardt (2004), while intuitively there is little reason to believe that the immediate retest of retrospective recall measures would be unreliable, few studies have examined extended test-retest periods. Among those that have considered longer intervals between assessments, some report relatively poor reliability. These include Fergusson (2000), as previously discussed, as well as Offer (2000), who measured family relationships at ages 14 and 48 and reported relatively poor concordance.   However,

others examining events such as divorce report better reliability; for example one study of adult reporting of childhood parental divorce and death that had a test-retest interval of 18 months found 95% concordance (Finlay-Jones, 1981); however while the percentage of concordance is high, given that divorce is a very salient event, one would expect perfect recall.

Finally, pregnancy specific factors may be important determinants of reliability. The first such factor is mood state. Pregnancy and the postpartum period are associated with changes in mood. Studies examining the prevalence of depression during the time of pregnancy report fluctuations by trimester, as one systematic review found prevalence rates at 7.4%, 12.8%, and 12.0% for first, second, and third trimesters, respectively (Bennett, 2004). The postpartum time period may be one of particular vulnerability. Postpartum depression is most common in the first 3 months after delivery, but can be present up to one year after giving birth; one review estimates that 19% of new mothers might suffer from depression in the first 3 months after delivery (Gavin, 2005). Memory itself has been shown to decrease as a result of pregnancy and memory deficits have also been noted in the postpartum period (Gollan, 2013; Henry, 2007). Other studies suggest that pregnancy specific events may also be relevant to the ability to recall child abuse, particularly sexual abuse. For example, reporting and or reenactment of repressed memories of CSA has been associated with the act of labor (Leeners, 2006) and pregnancy related medical exams (Montgomery, 2016; Kendall-Tackett, 1998), and fetal sex (female) has been reported to evoke feelings of fear (Parratt, 1994).

Directional Reporting of Child Abuse and Neglect

Some studies have examined the relationship between maltreatment and physical health outcomes with the goal of investigating possible recall bias. In two of the more notable studies, investigators examined the relationship between a history of maltreatment and health outcomes, comparing the effects of prospective versus retrospective reporting (Widom, 1999; Raphael, 2001). Because associations with outcomes were only found with the retrospective assessment, the authors concluded that recall bias was present.

Although recall bias of maltreatment has not been examined with respect to perinatal outcomes, it is plausible that experiencing an adverse pregnancy outcome could lead to increased reporting of abuse, relative to those who have not experienced such an outcome. In other investigations of perinatal outcomes, where there was a clear gold standard measures, investigators found evidence of recall bias (e.g., Boeke, 2012; Drews, 1990; Hogue, 1975), although it did not necessarily have a substantial effect on point estimates (Drews, 1990). Recall bias is a serious concern because within the perinatal literature, most studies examining the relationship between maternal exposure to child maltreatment and outcomes rely on retrospective measures (e.g., Leeners, 2010; Diesel, 2014; Cammack, 2011).

Concluding Remarks on Child Maltreatment

Childhood abuse and neglect are common exposures. Universally applied definitions and measures have not been utilized, and retrospective measurement of

childhood abuse and neglect, while an acceptable measure, may be prone to under

reporting. Thus, due to misclassification of exposure, which may or may not be random

with respect to various factors, the relationship between childhood abuse and birth

outcomes such as preterm birth may be subject to bias. This is concerning because non-

differential misclassification tends to bias results towards the null and differential

misclassification can bias towards or away from the null. Further, if recall of abuse and

neglect is biased with respect to perinatal outcomes, as has been demonstrated in the

reporting of other exposures in relation to perinatal outcomes, bias may be differential

and biased either towards or away from the null. Thus, there is a need for studies which

examine reliability and determinants of the reliability of reporting of childhood abuse and

neglect, specifically around the time of childbirth. Such studies can help identify

conditions under which reporting is more or less likely to introduce misclassification,

particularly differential misclassification, which can be informative in designing studies

of relationships between child abuse/neglect and perinatal outcomes.

LITERATURE RELATED TO CHILD MALTREATMENT, PRETERM BIRTH, AND OTHER RELEVANT OUTCOMES

Studies of Child Maltreatment-Preterm Birth Associations and Related Studies

Direct evidence that child maltreatment is associated with PTB comes from seven

non-population based studies. Of the studies pertaining to preterm birth, five report

positive associations (Leeners, 2014; Noll, 2007a; Margerison-Zilko, 2016; Selk, 2016;

Stevens-Simon, 1993) and two report null findings. (Benedict, 1999; Grimstad, 1999).

Additional information about these studies is summarized in Table 2.1.

Table 2.1. Summary of Studies of the Child Maltreatment-Preterm Birth

Relationship

Study	Study Population	N	Design	Abuse Type	% with Abuse	% with PTB	Findings
Benedict, 1999	US, University Hospital	357	Cohort	Sexual Abuse	37%	13%	No association (measure of association not presented)
Grimstad, 1999	Norway	173	Case Control (for LBW)	Sexual abuse	14%	32%	No association (OR=1.2, p=.68)
Noll, 2007	DC metro area	123	Prosp. Cohort	Sexual Abuse (via CPS records)	45%	16%	Positive association OR= 2.8 (95% CI: 1.36-4.24). Partially mediated by prenatal alcohol exposure
Leeners, 2014	Germany	255	Cohort	Sexual Abuse, Physical Abuse	33%	?	Positive association (ORs= of 2.6 and 2.7 for sexual and physical abuse p=.0,2)
Margerison-Zilko, 2016	Michigan (POUCH Study)	2,559	Cohort	Sexual Abuse, Physical Abuse	?	<37 wks= 11% <34 wks= 4%	Sexual abuse during childhood alone (OR for late PTB= 1.5 (1.0, 2.2); Sexual abuse during childhood and

							adulthood OR for late PTB=2.2 (1.1, 4.5)
Stevens-Simon, 1993	Rochester, NY	126	Cohort	Sexual or Physical Abuse	?	?	Positive association (measure of association not presented)
Selk, 2016	United States (Nurses Health Study)	51,434	Cohort	Sexual Abuse, Physical Abuse, Harsh Parenting (Emot. abuse, neglect and/or physical abuse)	Physical Abuse= 54% Sexual Abuse= 33% 11% Forced sexual activity= 11% Harsh Parenting =8%	8%	Positive association for forced sexual contact OR=1.22, (95% CI 1.10- 1.35)

There are significant methodological shortcomings in this set of studies, particularly in earlier studies. One of the more important limitations is the focus on sexual abuse alone, although recent studies have broadened the types of maltreatment considered. Most studies fail to measure other potentially important characteristics of abuse; most do not incorporate timing of abuse and none of the studies distinguished perpetrator type. There are also important limitations to outcome measures. Most studies relied on self-reported outcomes, and only one study considered distinctions between early and late PTB. Finally, none of the studies were nationally representative population based samples. Thus, while there is preliminary evidence of associations

between child abuse and PTB, further studies are needed to draw more definitive conclusions.

Other studies have also examined the relationship between PTB and childhood adversity, defined more broadly.   One study found that foster care placement, which is correlated with child abuse, was strongly associated with preterm birth (Bublitz, 2014). Another study found a relationship between the total score on the Adverse Childhood Experiences Scale, which includes household dysfunction in addition to abuse, and PTB, although it did not examine relationships with individual maltreatment types specifically and PTB (Christiaens, 2015). Other studies have examined the effect of child abuse and or other forms of adversity on additional related perinatal outcomes, namely low birth weight (birth weight less than 2500 grams). Harville (2010) reported a dose-response association between the number of adverse childhood experiences, including parental and financial hardship, family dysfunction (e.g., alcoholism, family tension), family structure dysfunction (e.g., foster care, single parent household, contact with social services) and low birth weight, as well as PTB.

Other studies examining chronic, socially entrenched stressors (but not necessarily from the preconception period) add plausibility to a relationship between early life stress and preterm birth. One notable example is lifetime racism and/or discrimination. Among studies that have examined the relationship between perceived racism and preterm birth, most report positive associations (e.g., Giurgescu, 2011; Rankin, 2011; Rosenberg, 2003); although this is not a universal finding (e.g., Misra, 2010; Slaughter-Acey, 2016). Other disparities, including racial segregation (Kramer, 2010; Mendez, 2014), and neighborhood inequalities, such as neighborhood deprivation

and crime, (Janevic, 2010; Messer, 2006) provide additional support for an association between chronic stressors and PTB.

Despite limitations in studies specifically pertaining to the relationship between childhood abuse and neglect and PTB, adverse childhood experiences, including abuse and neglect have also been directly related to subsequent stress-sensitive health conditions in adulthood, such as cardiovascular disease, autoimmune disease, liver disease, chronic fatigue syndrome, and gastrointestinal disorders (Borsini, 2014; Dong, 2003; Dong, 2004; Dube, 2009; Heim, 2006; Rooks, 2012). Further, several of these papers, namely those derived from the Adverse Childhood Experiences (ACE) study, have demonstrated the presence of a dose-response relationship. Also, there is evidence of a relationship with additional reproductive outcomes, including fetal death (Hillis, 2003), the timing of reproductive milestones such as age at menarche (Boynton-Jarrett, 2013; Li, 2014; Wise, 2009) and the onset of perimenopause (Allsworth, 2004).

Relationships Between Child Abuse and Neglect and Potential Mediators of Preterm Birth

There is also literature supporting a relationship between child abuse/neglect and multiple potential mediators of preterm birth. Several pathways with links to childhood maltreatment and PTB are relevant. Broadly, these can be conceptualized as "upstream" psychosocial and behavioral factors and "downstream" biological mediators known to be direct antecedents of preterm birth. Upstream factors can encompass both the preconception period, including distant preconception, and prenatal periods. For some of

these factors, particularly those related to stress, behaviors before pregnancy or in the early part of pregnancy may be most influential since physiologic and psychological reactivity to stressors is attenuated as pregnancy progresses (Christian, 2012). In this model, upstream factors directly drive biological dysregulation during pregnancy, ultimately leading to preterm birth.

Figure 2.1. Conceptual Framework

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|                                                  |
|        Exposure to Abuse and Neglect as a Child  |
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|                                                  |
| Preconception and Prenatal Upstream Psychosocial |
|   and Behavioral Mediators (distress, social     |
|    support, maladaptive behaviors (drug use,     |
|   obesity, eating disorders, sexual),            |
|              revictimization)                    |
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+--------------------------------------------------+
|                                                  |
|    Downstream Biological Mediators During        |
|     Pregnancy (infection/inflammation,           |
|  hypothalamic-pituitary adrenal-placental        |
|   responses, vascular pathophysiology)           |
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|                                                  |
|                 Preterm Birth                    |
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In terms of more precise pathways through which child abuse may be linked with preterm birth, the figure below depicts plausible paths. Some pathways between abuse and preterm birth are mediated through multiple upstream mediators (e.g., child abuse leads one to enter abusive relationships as an adult, which leads to depression, then leading to inflammation during pregnancy, and finally leading to preterm birth) whereas others are more direct (e.g., abuse leads to cocaine use that persists into pregnancy, which leads to gestational hypertension, then leading to preterm birth). The first part of this section concentrates on relationships between abuse and upstream mediators which have been linked to preterm birth, and the second half describes biological pathways involved in preterm birth that may be linked to child abuse, and how they may be linked to upstream mediators.

Figure 2.2. Detailed Conceptual Framework
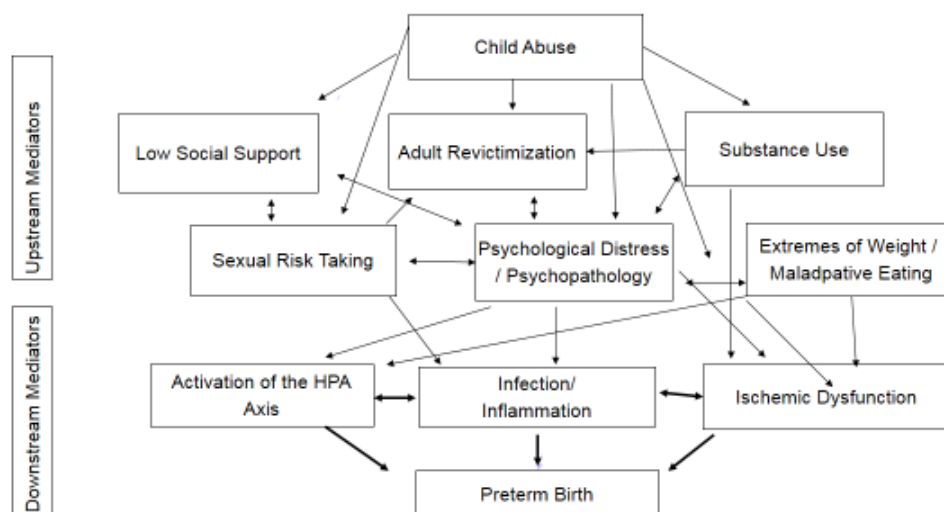
Upstream Mediators: Psychological Distress/ Psychopathology

Psychological distress may manifest in various forms, such as perceived stress, anxiety and depression. The relationship between psychological distress and health outcomes, including PTB, may be mediated by several factors, as well as other pathways, such as substance abuse and eating disorders. As mentioned previously, multiple studies report consistent, but small associations between these various forms of psychosocial stress and PTB (Dole, 2003; Dunkel-Schetter, 2011; Nordentoft, 1996; Shapiro, 2013; Wadhwa, 1993; Yonkers, 2014).

Psychopathology is the most studied consequence of child maltreatment. Several studies have related child abuse and neglect to depression and anxiety disorders (Dvir, 2014; Infurna, 2015; Nemeroff, 2016; Verdolini, 2015) and pregnancy specific studies have also found generally consistent positive associations with these conditions and abuse. Post-traumatic stress disorder (PTSD) is a particularly relevant consequence of exposure to trauma, and in women, sexual traumas, such as those experienced via childhood sexual abuse, have been linked with highest risks of developing PTSD (Kessler, 1995). Studies report associations between perceived stress in pregnancy and childhood trauma (Benedict, 1999), as well as positive associations with depression (Barrios, 2015; Leeners, 2014; Lev-Wiesel, 2010; Robertson-Blackmore, 2013), suicidality (Farber, 1996), and PTSD (Lev-Wiesel, 2010; Seng, 2008).

Upstream Mediators: Social Support

Poor social support may also serve as an intermediate between childhood trauma and preterm birth. Low social support has been associated with PTB, although the evidence is not uniform and the source of social support and its strength and/or consistency may be important factors (Dole, 2004; Hoffman, 1996). Clinical trials of social support have also yielded mixed findings, though studies of a more intensive intervention, group prenatal care, which included increased peer and family support, have shown potential in reducing risk of PTB (Ickovics, 2007; Picklesimer, 2012). Proxies of low social support are also associated with preterm birth, particularly being unmarried or not cohabitating with the baby's father (reviewed in Shah, 2011).

Women with histories of abuse may experience low social support for a few reasons. First, it is plausible they may have less support from their parents from childhood into adulthood if their parents were perpetrators of the abuse. Second, these women may be hesitant to trust their partners and may enter dysfunctional relationships during adulthood and not receive optimal partner support. (Barrios, 2015). This, in turn can affect their risk of experiencing stress and place them at risk for depression and other mental health disorders.

Upstream Mediators: Revictimization During Pregnancy

Multiple studies suggest that IPV, in and of itself, is an important risk factor for PTB (reviewed in Hill, 2016). Some of these studies employ longitudinal designs to capture reporting of prospective abuse (e.g., Alhusen, 2013), suggesting that recall bias cannot solely account for observed associations. Intimate partner violence has been

linked to maladaptive coping mechanisms, which may include other risk factors behaviors that are risk factors for PTB (e.g., smoking; Udo, 2016).

Child abuse and neglect may predispose women to entering relationships later in life that mirror their upbringing, and has thus been widely linked to subsequent exposure to IPV in studies of both adults and teenage mothers (Barnes, 2009; Barrios, 2015). There is considerably variability in the risk of revictimization. A recent meta-analysis found risks for sexual abuse ranging from 12-70% (Bidarra, 2016). If the true risk of revictimization approaches the upper end of reported estimates, that suggests this is an important avenue of secondary prevention measures.

Upstream Mediators: Substance Use

Another pathway through which childhood trauma may lead to preterm birth involves the adoption of maladaptive behaviors, namely substance use. A connection between stress exposures, including child abuse, and multiple forms of substance abuse has been widely reported (Allem, 2015; Dube, 2003; Ford, 2011); factors such as low self-esteem and depression may mediate this association. Although evidence is relatively stronger for intrauterine growth retardation, preterm birth is associated with street drugs, particularly cocaine (Gouin, 2011), but also smoking (Ion, 2015). Evidence for binge drinking is more mixed, with some but, not all studies supporting an association (Cooper, 2013). Substance abuse, particularly smoking, was highly prevalent in the 1990s (CDC, 2016), which could be a factor in the relatively higher prevalence of PTB, compared to 2007-present, in births during the 1990s and early 2000s.

While the relationship between childhood trauma and substance abuse in non-pregnant populations is well established, literature pertaining to this relationship specifically during pregnancy is less conclusive and concentrates on sexual abuse, although small sample sizes hamper several studies. Moreover, substance use can negatively impact fertility (Alvarez, 2015) and pregnant women commonly try to abstain during pregnancy (Alves, 2013; Nykjaer, 2014), so it is unclear if findings in non-pregnant populations extend to pregnant populations. Regarding smoking in pregnancy, a small study from Norway found a positive association with CSA (Grimstad, 1999) and a larger study from inner-city Philadelphia reported a relationship between adverse childhood experiences and smoking (Chung, 2010). Noll (2007) noted an association between CSA and alcohol consumption; however, other studies did not replicate this association (Benedict, 1999; Grimstad, 1999). However, studies looking at adverse childhood experiences, more broadly defined, reported associations with alcohol use. Chung (2010), Frankenberger (2015), and Hans (2010) found an association between childhood trauma and street drug use, but other studies (Benedict, 1999; Hutchins, 1997) had null findings. Finally, El Marroun (2008) found an association between child abuse and neglect and cannabis use in early pregnancy.   An important limitation of these studies is that they did not specifically examine cessation of these behaviors during pregnancy as the outcome, making it difficult to ascertain whether abused women may benefit from additional support in abstaining from substance use.

Upstream Mediators: Risky Sexual Behaviors

Sexual risk taking (i.e., early onset of sexual activity, multiple partners, lack of protection) is primarily linked with preterm birth through increased risk of sexually transmitted infections (STIs). The association between STIs, particularly chlamydia and gonorrhea, and preterm birth has been noted in several studies (Johnson, 2011; Liu, 2013; Silva, 2011).

Many victims of abuse may cope with trauma by reenactment of it (McElvaney, 2010; Penning, 2014; van der Kolk, 1989). This may lead to sexual risk taking as defined above (Chiang, 2015; Sansone, 2009). A direct link has been made with the presence/number of sexually transmitted infections among women of childbearing age and history of abuse (Buffardi, 2008; Hillis, 2000; Widom, 2009). Sexual risk taking in abuse victims can be a result of psychological distress in response to the original trauma and future risk taking by itself can also lead to psychological distress (Pittenger, 2016).

Upstream Mediators: Extremes of Weight / Eating Disorders

Last, extremes of weight have been separately linked to both preterm delivery and childhood trauma. Obesity may be protective against spontaneous preterm delivery, although it is a risk factor for medically indicated preterm deliveries via the development of conditions such as gestational diabetes and preeclampsia (Salihu, 2008; Young, 2016). Underweight status has also been linked with PTB (Girsen, 2016; Han, 2010).

A few studies have linked childhood trauma, weight extremes, and weight gain patterns specifically around the time of pregnancy. Recently, Diesel (2016) reported excessive gestational weight gain in maltreated women who were anxious, but not in those without anxiety. This may suggest that obesity and related behaviors may be an

adaption to the stress of childhood trauma, lasting into the perinatal period. An earlier study reported an association between excessive, non-optimal weight gains in women experiencing abuse (Johnson, 2002).   Diesel (2016), Nagl (2016), and Hollingsworth (2012) reported associations between childhood trauma and preconception obesity. Also, some research indicates a relationship between a history of child abuse (particularly sexual abuse) and disordered eating during pregnancy, including eating disorder symptoms (e.g., vomiting and laxative use) and concern about body shape during pregnancy (Senior, 2005). These findings are in line with several studies that have linked eating disorders to childhood trauma in the general adult population (Madowitz, 2015).

Downstream Mediators (Biological)

There are several biological pathways through which preterm birth may arise. In terms of immediately proximal mechanisms for spontaneous preterm birth, uterine contractions, stimulated by oxytocin and prostaglandins, and ripening of the cervix/ rupture of the membranes, stimulated by matrix metalloproteinases, lead to the onset of labor (Institute of Medicine, 2007). Previous attempts to isolate a single pathogenic process precipitating this common furthest downstream pathway have been largely unsuccessful; thus, current approaches to investigating PTB recognize that it is a complex condition driven by multiple biologic pathways (Institute of Medicine, 2007; Esplin, 2016). The immediate cause of non-spontaneous PTB is labor induction or cessation section due to risks to the mother/fetus. This section focuses on three biological pathways have been linked with maltreatment and psychosocial effects of maltreatment

(i.e., upstream mediators as discussed before): 1) activation of the hypothalamic pituitary adrenal (HPA) axis 2) infection/inflammation 3) ischemia /vascular dysfunction.

Downstream Mediators: Hypothalamic Pituitary Adrenal (HPA) Axis

The HPA axis and its products have been implicated as a determinant of the onset of parturition. In particular, HPA activation has been shown to stimulate the release of placental corticotrophin releasing hormone (CRH), which several studies have associated with preterm birth (Holzman, 2001; McLean, 1995; Wadhwa, 1998; Wadhwa, 2004). Alterations in HPA responses to stress (e.g., cortisol awakening response) may also influence the length of gestation (Buss, 2009). Also, CRH binding protein (CRH-BP) modulates the effects of CRH. CRH-BP binds CRH with equal or stronger affinity than the CRH receptors. As a result, CRH-BP serves as an important regulator of the bond between CRH and its receptors (Westphal, 2006).

Cortisol and ACTH have been widely linked with both childhood trauma and resultant downstream psychosocial stress and psychopathology in non-pregnant populations (Bremner, 2007; Brewer-Smyth, 2008; Heim, 2009; Juruena, 2014; Stadler, 2017; Zohr, 2016). Evidence of these relationships in pregnant women is more limited. A recent study reported that childhood maltreatment affected CRH trajectories during pregnancy (Moog, 2016). By contrast, Chen (2010) reported no association between second trimester CRH levels and a history of adulthood or childhood physical, sexual, and emotional abuse, although this study did not specifically look at effects during

childhood alone. Other studies (Bublitz, 2012, Shea, 2007) have linked cortisol with childhood trauma history in pregnant women.

Dysregulation of the HPA axis may be linked to childhood trauma through a few different mechanisms. First, psychosocial stress and psychopathology has been linked with dysregulation of the HPA axis in the general adult population. Alterations in the cortisol awakening response (CAR) have been linked with major depression (Dedovic, 2015) and stressors such as unemployment (Gallagher, 2016) in non-pregnant individuals. Some studies have shown that psychosocial stressors during pregnancy are linked with cortisol awakening patterns (Simon, 2016), and chronic depressive symptoms have been linked with blunting of the CAR (Seth, 2016). Evidence linking psychopathology to CRH is more limited (Hobel, 1999) with some studies reporting no association (Kramer, 2009). This could be in part related to the fact that some of these study assessments occurred later gestation and as mentioned previously, stress exposures later in pregnancy may not necessarily affect physiologic responses since they are progressively blunted as gestation advances (Christian, 2012).

Last, weight extremes and eating behaviors may affect the HPA axis in pregnancy. Both underweight and obesity have also been linked with abnormalities in the CAR (Incollingo Rodriguez, 2015; Monteleone, 2016). Undereating and binge eating behaviors have also been linked to cortisol abnormalities (Lo Sauro, 2008; Monteleone, 2016).

Downstream Mediators: Immune Function/Dysregulation

The second downstream pathway through which child abuse and neglect may be related to preterm birth is immune dysregulation and inflammation. Infection and inflammation, particularly in response to intrauterine or reproductive tract infections, are established risk factors for preterm birth (Romero, 2001; Romero, 2014), especially early preterm birth (e.g., < ~32 weeks). In fact, most cases of early preterm birth show signs of intrauterine infection, with as many as 80% of women delivering prior to 30 weeks of gestation showing evidence of histologic chorioamnionitis (Goldenberg, 1996). The most common infection in women of reproductive age, bacterial vaginosis, has been associated with a 2-fold increased risk of preterm birth and higher risks are associated with early preterm birth (Nelson, 2002; Witkin, 2015). Also, various systemic infections, such as pneumonia, pyelonephritis, malaria, typhoid fever, periodontal disease have been associated with preterm labor and delivery (Fell, 2016; Romero, 2001), although many of these associations are weaker than for reproductive tract infections. Not surprisingly, for cytokines, a meta-analysis found that a pro-inflammatory cytokine in response to infection, IL-6, in cervicovaginal fluid and IL-6 and C-reactive protein (CRP) in amniotic fluid were strongly associated with spontaneous preterm birth, but there was no association when measured in plasma, implying that localized, rather than systemic, inflammation is an important factor in spontaneous preterm births (Wei, 2010).

Childhood trauma has also been linked to various markers of infection and inflammation. As previously mentioned, the relationship between childhood trauma and infection may also be due to risky sexual behaviors or perhaps even the abuse itself, as childhood trauma, particularly sexual abuse, can expose a woman to STIs. There is only one study reporting a relationship between infection during pregnancy (specifically

bacterial vaginosis) with childhood sexual abuse, low childhood SES and chronic discrimination (Cammack, 2011); however, other multiple studies have linked child abuse to other markers of infection in non-pregnant populations (Baumeister, 2016) . Population-based studies have also observed the women who were maltreated as children have higher levels of CRP (Bertone-Johnson, 2012; Danese, 2007; Danese, 2009), and a higher prevalence of autoimmune disorders (Dube, 2009). .

Child maltreatment may be linked to infection/inflammation through various upstream psychosocial mechanisms.   Several studies have linked psychosocial stressors and psychopathology to immune factors and infection (Kiecolt-Glaser, 2002) and a small, but growing literature supports this relationship during pregnancy, as positive associations exist for cytokines (Coussins-Read, 2007) and bacterial vaginosis (Culhane, 2001; Culhane, 2002).. Among non-pregnant women cell-mediated inflammatory reactions have been linked with PTSD due to sexual or physical abuse (Altemus, 2003), as well as elevated T-cell activation in women with CSA and concurrent PTSD (Lemieux, 2008). Another important pathway involves weight. Obesity in particular has been strongly linked to inflammation (Aronson, 2015) and it has been broadly linked with immunologic dyfunction (Ray, 2016). Finally, substance use, particularly smoking has been linked with various inflammatory changes (Rom, 2016).

Downstream Mediators: Ischemia/ Vascular Disease

The third set of downstream mediators involve vascular disease, which has been identified as a risk factor for PTB. Vascular disease in pregnancy can manifest as

placental pathology or complications such as preeclampsia, hypertension, intrauterine growth restriction, and bleeding disorders (Burton, 2009; Wadhwa, 2001). Evidence of an association between vascular pathology and preterm birth is more consistent for medically indicated preterm birth than idiopathic PTB (McElrath, 2008), although there is also evidence of an association for spontaneous preterm birth (Kelly, 2009).

Childhood maltreatment is plausibly linked with vascular pathways through stress mechanisms. In non-pregnant populations, the relationship between stress and vascular disorders is well-established, and there is also growing evidence to support a relationship between childhood trauma and vascular disorders (e.g., Dong, 2004). Among pregnant women, some studies support a relationship between stress related constructs, particularly anxiety, and placental vascular function (e.g., Sjostrom, 1997, which assessed the role of state anxiety as related to pulsatility index; and Teixeira, 1999, which assessed the role of state and trait anxiety as related to uterine artery resistance), as well as a relationship between stress hormones and fetal hemodynamics and gestational hypertension. However, these studies are limited by their small sample size and lack of population based sampling. Finally, despite limited research that elucidates the specific mechanism through which stress causes vascular disease in pregnant women, studies measuring various types of stress (e.g., job stress, perceived stress) have linked stress with preeclampsia (Zhang, 2013).

Other upstream mediators are also likely relevant to vascular disease driving risk of preterm birth. Obesity is a well-established risk factor for hypertension and is a risk factor for pregnancy related vascular complications (Mission, 2015). Although smoking is a risk factor for preterm birth, the fact that it is actually protective against preeclampsia

argues against vascular pathways being the underlying mechanism (Wei, 2015). However, other forms of drug use, such as cocaine use, (Ferdinand, 2000) have consistent positive associations with hypertension.

Concluding Remarks

Although direct evidence of a relationship between maternal exposure to child abuse and neglect and PTB is limited, maltreatment has been linked to related outcomes with shared etiology. Several psychosocial, behavioral, and biological factors have been linked to child abuse/neglect and both spontaneous and medically indicated preterm birth. Thus, relationships between a maternal history of child abuse and neglect, PTB, and these mediators are biologically plausible, particularly given that preterm birth has increasingly been recognized as being a condition driven by diverse underlying biological etiologic mechanisms.

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CHAPTER 3

Study Populations

This chapter providers additional information about the two study populations and enrollment procedures beyond what is detailed in chapters 4-7.

Data Source 1 (Aim 1): Emory Women's Mental Health Program

Description of Sample

Original data collection was conducted utilizing three existing pregnancy cohorts enrolled through the Emory Women's Mental Health Program in the Department of Psychiatry and Behavioral Sciences. These studies are convenience samples where women were recruited through community mental health and obstetric referrals. These three studies consist of projects pertaining to 1) predictors of relapse of bipolar disorder (Study Title: Bipolar Disorder in Pregnancy: Predictors of Morbidity; PI: D. Jeffrey Newport; Grant Number R01MH071531); 2) effects of epileptic drugs and psychotropic medications in women with a history of with epilepsy, Tourette's syndrome, major depression (MD), bipolar disorder (BPD), panic disorder (PD), and/or obsessive compulsive disorder (OCD) (Study Title: Medications in Pregnancy: Defining Exposure; PI: Zachary Stowe; Grant Number P50MH068036); 3) and a study examining the impact of perinatal events, genetic and environmental exposures among women fulfilling DSM-IV criteria for Major Depressive Disorder, Obsessive Compulsive Disorder, Generalized Anxiety Disorder (GAD), Post-Traumatic Stress Disorder, and non-psychiatric controls

(Study Title: Perinatal Stress and Gene Influences: Pathways to Infant Vulnerability; PI: Zachary Stowe; Grant Number P50MH077928).

In these three studies, the 1975 women completed a Childhood Trauma Questionnaire instrument.   From July 2010-December 2011, the time frame in which the follow-up study occurred, a total of 247 women mostly less than 5 years postpartum completed a second Childhood Trauma Questionnaire.   Three of these women were inadvertently administered the second questionnaire while still pregnant, and thus excluded from analyses. Participants completed a second questionnaire between 18.1 and 369.9 weeks after the index pregnancy (median time between T1 and T2 = 140.7 weeks; IQR 79.3, 213.7). Most participants completed the original questionnaire in the preconception period (median=44.4 weeks before delivery (IQR: 25.6 - 96.3 weeks)) and the second questionnaire was completed for most women between three months and three years postpartum (median= 66.4 weeks after delivery; IQR: 35.7-133.5). Some participants filled out the questionnaire at scheduled research appointment at approximately 3, 6 or 12 months postpartum, so there was clustering around these time points; otherwise, women participated at the next scheduled clinical assessment. Women were able to participate as long as they were within 5 years postpartum. In January 2011, there was a test pilot project of 73 of the subjects who did not present for study or clinic visits within the last year but were less than 5 years postpartum and 12 of these participants returned a completed questionnaire.   In light of the low response rate, no further subjects were recruited via mail.

Additional Inclusion/Exclusion Criteria

Additional inclusion criteria used for recruitment in the original three studies were as follows: (all studies): woman age 18-45; Bipolar Disorder in Pregnancy & Postpartum Period study: euthymic at conception, enrollment at <13 weeks of gestation, if taking mood stabilizers, only those that are FDA approved; Stress in Pregnancy Study: Planning pregnancy or currently pregnant < 16 weeks gestation by last menstrual period, able to identify the biological father of the baby; Medications in Pregnancy Study: Baseline TSH within normal range, history of treatment with medications appropriate to respective diagnoses, a history of illness indicative of a high likelihood of medication exposure during pregnancy and/or the first postnatal year. The following exclusion criteria were also applied: (all studies) active suicidality or homicidality, psychotic symptoms, current substance use disorder/positive drug screen; Stress in Pregnancy Study: Primary diagnosis of bipolar disorder, schizophrenia, and/or currently active eating disorder.

Data Source II: (Aims 2 and 3): National Longitudinal Study of Adolescent to Adult Health (Add Health)

Description of Sample

The National Longitudinal Study of Adolescent to Adult Health (Harris, 2009 interviewed over 90,000 adolescents in grades 7 through 12 during 1994-95 in schools located in 80 communities throughout the United States. A nationally representative subset of participants was sampled for additional in-home surveys (Wave 1: N=20,745; 78.9% participation rate) and followed up as young adults in 2001-2002 (Wave 3: ages 18 to 26; N=15,197) and 2008-2009 (Wave 4: ages 24 to 32; N=15,701).

Figure 3.1: Add Health Sampling Scheme *(from Harris, K.M., C.T. Halpern, E. Whitsel,*

J. Hussey, J. Tabor, P. Entzel, and J.R. Udry. 2016. The National Longitudinal Study of

Adolescent to Adult Health: Research Design.

http://www.cpc.unc.edu/projects/addhealth/design. Permission to use received from Add

Health)
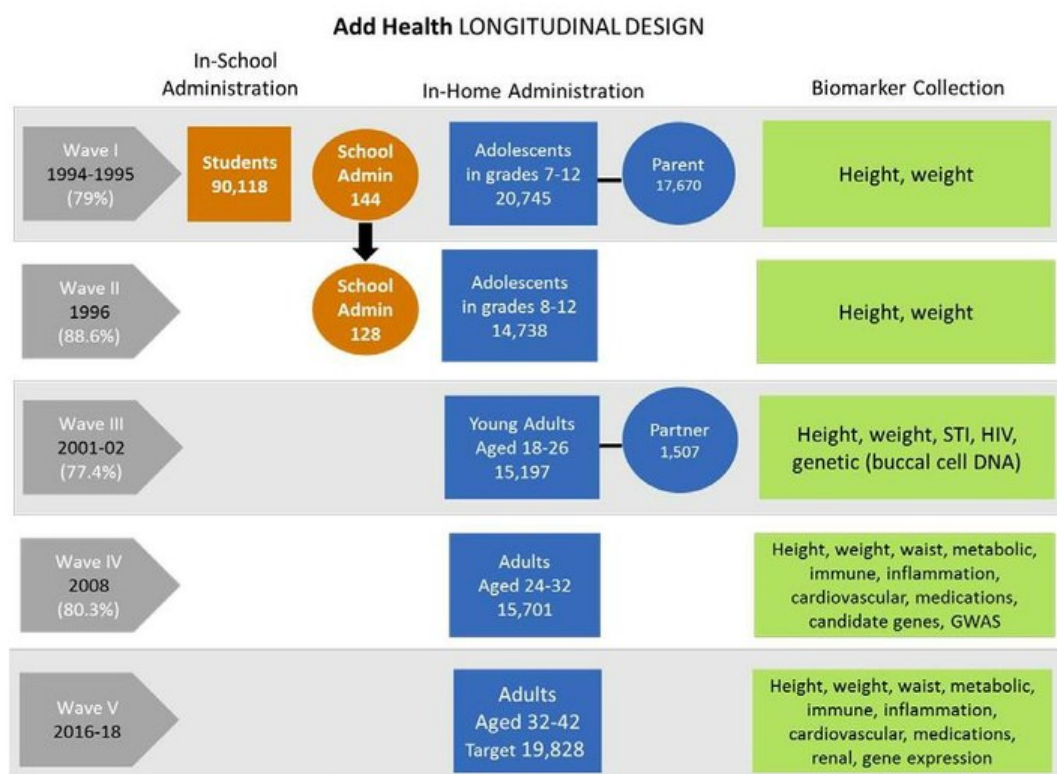
Sampling methods and stratification methods resulted in 80 schools that were

representative of US schools with respect to region of country, urbanicity, size, type, and

ethnicity.   For each high school selected, one feeder school (typically a middle school,

but the same school could serve as its own feeder if it enrolled middle school students)

was selected with a probability proportional to its student contribution to the high school. A total of 132 schools participated in Add Health study.

Students eligible to be selected for the at home survey were drawn from students who completed the In-School Questionnaire from a selected school plus those who did not complete a questionnaire but were listed on a school roster for each school that had been sampled. Students in each selected school were stratified by grade and sex. About 17 students were randomly chosen from each stratum so that a total of approximately 200 adolescents were selected from each of the 80 schools. Also, selected racial/ethnic minority groups, siblings, and those with disabilities were oversampled. One parent, the mother if available, was also interviewed at the baseline interview.

Aim 2 and 3 Study Populations

For dissertation aims 2 and 3, we considered two distinct study populations that constitute subsamples of the data above.   Aim 2 sampled the first birth among women who ever reported a live birth, had a singleton gestation, and had data on abuse/gestational age at delivery. The selection scheme for these 4,181 women is depicted in Figure 2 below.

Figure 3.2. Aim 2 Sampling Scheme: Selection of First Live Births

```
┌─────────────────────────────────────┐
│  Participation in Wave 4 (N=15,701)  │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│      Sampling weight available       │
│            (N=14,800)                │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│  Had pregnancy/fathered pregnancy    │
│   that led to live birth (N=7,174)   │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│      Female participant(N=4,349)     │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│     Singleton gestation (N=4,229)    │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│   Data on any of the abuse variables │
│            (N=4,228)                 │
└─────────────────────────────────────┘
                  ↓
┌─────────────────────────────────────┐
│        Data on gestational age       │
│    (first live birth) (N=4,181)      │
└─────────────────────────────────────┘
```
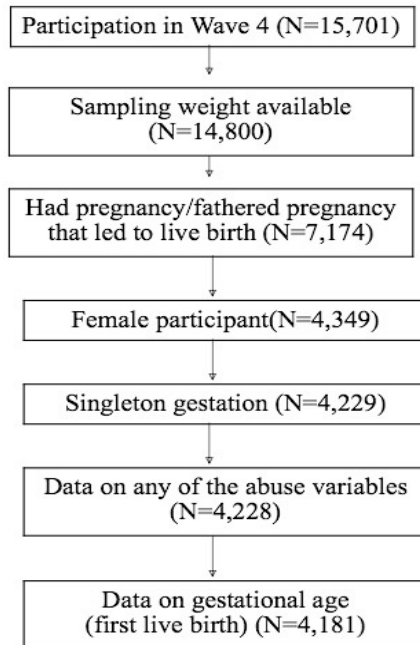
Aim 3 included women who self -reported being pregnant at the time of the Wave

3 (N=305) and Wave 4 (N=519) interviews and had data on smoking behaviors.   Only

women who participated in follow-up waves 3 and 4 were included so that appropriate

sampling weights could be used to combine the pregnant women from both waves (Wave

3, N=266, Wave 4, N=421). 16 women reported being pregnant in both waves and for

these analyses we included their data from wave 3, rather than wave 4 to create more

balance between the two samples, yielding a total sample size of 671 women. Of these

women, 272 reported ever smoking regularly and constituted the primary sample for

analyses.   The selection scheme is detailed further in Figure 3.

Figure 3.3. Sampling Scheme for Aim 3

```
┌─────────────────────────────────┐
│   Participation in Waves 3 and 4 │
│            (N=13,034)            │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     Sampling weight available    │
│            (N=12,288)            │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│   Woman who was pregnant at time │
│  of Wave 3 or 4 interview (N=671)│
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│    Ever reported regular smoking │
│             (N=272)              │
└─────────────────────────────────┘
```
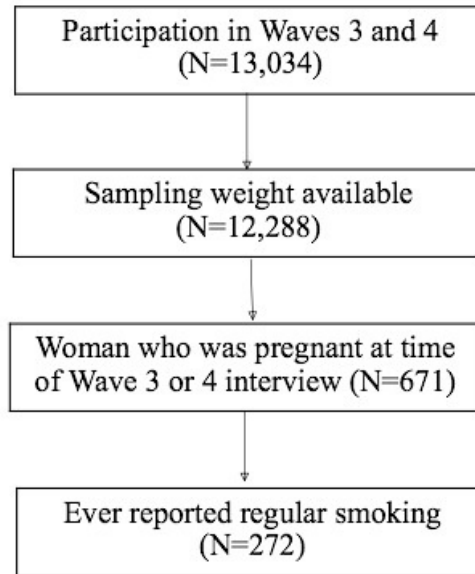
Effect of the Sample Design on Analysis

The Add Health study is a clustered sample that utilized unequal probability sampling. To produce point estimates that are reflective of the source population, the probabilities of selection, which were proportionate to school size, must be accounted for in analyses. Failure to incorporate the sampling weights often underestimates standard errors, increasing the probability of making a type I error. In this dissertation, the statistical package SAS callable SUDAAN was utilized to produce estimates and standard errors that incorporate selection probabilities.

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    The National Longitudinal Study of Adolescent to Adult Health: Research
    Design.   http://www.cpc.unc.edu/projects/addhealth/design

CHAPTER 4

Test-Retest Reliability of Retrospective Self-Reported Maternal Exposure to Childhood Abuse and Neglect

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Test-retest reliability of retrospective self-reported maternal exposure to childhood abuse and neglect

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Abstract

Retrospective reports of exposure to childhood trauma indicate it is common. There is growing interest in relationships between maternal exposure to childhood adversity, perinatal mental health, and pregnancy outcomes. The goal of this study was to describe the self-reported prevalence and test-retest reliability of exposure to childhood maltreatment using the Childhood Trauma Questionnaire among adult women around the time of pregnancy. A substantial proportion of women reported exposure to maltreatment and reliability was generally at least moderate, indicating consistent reporting.

Introduction

Childhood trauma is commonly reported (CDC 2010). In the Adverse Childhood Experiences study, adult women retrospectively self-reported exposure to sexual (24.7%), physical (29.0%), and emotional (13.1%) abuse, and to physical (9.2%) and emotional (16.7%) neglect before age 18 (Felitti et al. 1998). Such exposures have been associated with vulnerability to psychopathology and poor physical health in adults (Shonkoff and Garner 2012). Maltreatment is also associated with higher rates of preterm birth and fetal loss (Hillis et al. 2004; Noll et al. 2007) as well as behavioral and psychosocial risk factors for these outcomes among pregnant women, such as substance abuse (Noll et al. 2007) and depression (Chung et al. 2008). With growing interest in preconception health and life course stressors as determinants of perinatal outcomes (Kramer et al. 2011), this literature is likely to expand.

Most studies of the prevalence and long-term implications of child abuse and neglect rely on adult recall of childhood experiences which may be subject to selective recall because of the sensitive/taboo nature of this subject. Studies of test-retest reliability can inform possible bias. The Childhood Trauma Questionnaire (CTQ) is widely used in various populations and has generally shown good test-retest reliability (Bernstein and Fink 1998). However, many of these studies are limited in scope (e.g., utilize short test-retest periods and specialized, non-population based samples).

To our knowledge, no studies have examined reliability proximate to pregnancy

(i.e., preconception, perinatal, and postpartum periods), utilizing the CTQ or any other measure. Studies of the overall adult population may not be generalizable to this context because memory and factors influencing memory such as mood state are influenced by pregnancy itself (Buckwalter et al. 2001). Also, an anecdotal literature suggests that pregnancy-specific events, including having a baby of a certain gender, traumatic deliveries, and initiation of breastfeeding, may influence recall of trauma (Leeners et al. 2006). The aim of this paper is to begin to fill in these gaps by describing women's self-reported exposure to childhood trauma at two times specifically around the time of pregnancy.

Materials and Methods

Study participants were drawn from a convenience sample of pregnant women aged 18–45 at the Emory Women's Mental Health Program (WMHP) participating in observational studies of the perinatal course of psychiatric illness from January 2002 to December 2011. Women were referred to the WMHP by community obstetric or psychiatric care providers. Most participants had lifetime histories of a mood and/or anxiety disorder, and many were receiving psychotropic treatment. All participants provided written informed consent, and study participation was independent of their treatment. This research was approved by the Emory University IRB.

Exposures

A retrospective history of childhood trauma was assessed using the Childhood Trauma Questionnaire Short-Form (CTQ; Bernstein and Fink 1998). Three domains of abuse (sexual, physical, and emotional), and two domains of neglect (physical, emotional) are measured with five questions each, on a 5-point likert scale. Trauma was analyzed both by examining continuous distributions and according to the recommended ordinal cutpoints (no, low, medium, or high trauma). Further, all individual trauma scales were dichotomized in two ways: 1) according to the originators' recommended cutpoints for no or low trauma versus medium or high trauma and 2) any versus no trauma. The CTQ also contains a denial scale used to identify possible underreporting of trauma. In the current study, denial was operationalized as any denial at either administration versus no denial.

Women completed the initial CTQ prior to conception or during pregnancy. Administration of the CTQ was repeated after the completion of the pregnancy; however, some women had conceived again and were pregnant or had completed a subsequent pregnancy prior to the second administration of the CTQ. 12 subjects completed the questionnaire through the mail and the remainder during clinic or research visits.

Analyses

Differences in characteristics of women completing one versus two CTQ assessments were computed with chi-squared tests, Fisher's exact tests, and t-tests. Test-retest reliability was primarily examined by computing Cohen's *kappas* for dichotomized trauma variables, weighted *kappas* for the four ordinal trauma severity categories, and

intraclass correlations (ICCs) for log transformed continuous measures, all with 95%

confidence intervals. Due to deviations from a fifty percent exposure prevalence to

individual abuse categories, prevalence-adjusted and bias-adjusted *kappas* (PABAK)

were also computed (Byrt et al. 1993). Further, prevalence and bias indices, and percent

discordance, both overall and differentially according to reports of abuse/lack of abuse

(i.e., positive and negative agreement) were computed as suggested by Byrt et al. (1993).

Kappas were interpreted according to guidelines from Landis and Koch (0 to 0.2, poor;

0.2 to <0.4, fair; 0.4 to <0.6, moderate; 0.6 to <0.8, substantial; and 0.8 to 1.0, almost

perfect) (1977). Regarding ICCs, two-way ANOVA model ICCs were computed to take

into account variability that may be associated with preconception/prenatal and

postpartum time periods.

Results

A total of 1975 participants completed at least one CTQ; 247 participants

completed a second CTQ between 18.1 and 369.9 weeks after the index pregnancy

(median time between T1 and T2 weeks = 140.7 (IQR: 79.3, 213.7). Three women with

repeat CTQ administrations were not included in reliability analyses due to

administrative timing errors (i.e., second CTQ was administered prior to delivery). All

subscales demonstrated good internal consistency (Cronbach's *alpha* at both timepoints

.58-.93).

Women were predominantly white, non-Hispanic, married, and most pregnancies

were planned and desired (Table 1). Compared to participants who completed the repeat

CTQ, participants completing only one CTQ differed on levels of education, race, marital status, pregnancy planning, and were more likely to report exposure to sexual abuse and physical neglect at the first assessment (Sexual Abuse 28.31% vs. 22.13% p=.043; Physical Neglect, 29.21% vs. 20.49%, p=.0045).

For most types of maltreatment, a substantial proportion of participants reported exposure, and inclusion of the low category of abuse substantially increased the reported prevalence for all subtypes except for sexual abuse (Table 2). Log transformed continuous scores were slightly higher at T2 than T1 for sexual abuse (mean difference 0.030, 95% CI .005-.054) but there was no statistically significant change for categorical definitions of abuse. For dichotomous categorizations of maltreatment, McNemar tests revealed no significant differences in the number of women reporting abuse at T1 but not T2 or vice versa. Approximately one quarter of participants (N=61) exhibited some denial at either time point.

Table 2 shows-test retest reliability for the liberal and conservative dichotomized definitions of the five trauma categories. With the exception of physical neglect (where the *kappa* was below .4 for the more liberal definition), both *kappa* and PABAK scores were at least moderate. PABAK scores tended to be higher than Cohen's *kappa*, largely due to the deviation from a 50/50 distribution. The proportion of negative agreement was consistently higher than positive agreement. Weighted *kappas* followed a similar pattern (Emotional Abuse: .67 (.60-.73); Physical Abuse: .67 (.57-.76); Sexual Abuse: .75 (.66-.83); Physical Neglect: .44 (.31-.57); Emotional Neglect: .59 (.51-.67). Intraclass correlations were high for all trauma types (all r >.7).

Discussion and Conclusion

Retrospective self-reports of childhood trauma were common in this perinatal psychiatric population, with mostly moderate to substantial test-retest reliability between administrations prior to pregnancy outcome and up to five years after the pregnancy. Reported prevalences, particularly for the more conservative abuse definition, are similar to those reported by other studies utilizing the CTQ among women (Bernstein and Fink 1998; Matthews et al. 2014). Our findings of generally at least moderate reliability are also similar to those reported elsewhere (Bernstein and Fink 1998; Paivio 2001), although these studies relied on continuous trauma measurements in test-retest assessments.

Regarding the finding of smaller *kappas* for physical neglect, this trauma type is relatively underrepresented in the maltreatment literature (Stoltenborgh et al. 2013), as compared to other forms of maltreatment. In our study population, as likely others, women were more likely to be screened for other traumas as part of clinical assessments, which in our case usually occurred before administration of the CTQ. Thus, it is possible differential response priming may have influenced reliability.

Utilizing a study population that was recruited from a population of relatively homogeneous upper middle class white women with a history of psychiatric illness who participated in longitudinal studies introduces two noteworthy limitations. First, these highly compliant and motivated women may have been more likely to report abuse and neglect. Second, relatively homogeneous populations may yield decreased estimates of reliability since increased precision is needed to distinguish differences; therefore compared to more diverse populations of women around the time of pregnancy, our observed effect sizes may be underestimates.

In conclusion, this study offers some reassurance that the CTQ administered around the time of pregnancy yields adequate consistency. However, reliability does not necessarily translate to validity. Further research of misclassification of maltreatment as well as the magnitude and direction of any potential biases, particularly as they relate to associations between these exposures and perinatal outcomes, remains important. Related studies, including those utilizing alternative measures of trauma and those assessing the prevalence and reliability of other types of childhood adversity (e.g., poverty, parental death) should also be conducted.

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Table 4.1. Characteristics of Women Completing One or Two CTQ Questionnaires

	Completed 2 CTQs		Completed 1 CTQ	
Age at delivery	Mean=32.7 y	SD=4.5	Mean=33.3 y SD=5.5	
Education***				
12 years or less	2	0.82	151	8.90
13–15	42	17.21	360	21.21
16+	200	81.97	1186	69.89
Race**				
Asian	8	3.28	34	1.96
Black	12	4.92	170	9.82
Native American	0	0.00	23	1.33
Multiple races	3	1.23	30	1.73
Unknown	1	0.41	19	1.10
Pacific islander	0	0.00	1	0.06
White	220	90.16	1454	84
Ethnicity				
Hispanic	5	2.06	65	3.76
non-Hispanic	239	97.94	1666	96.24
Marital status***				
Divorced	5	2.06	58	3.36
Married	217	88.93	1402	81.18
Never married, lives with	7	2.87	158	9.15
Never married, lives alone	11	4.51	90	5.21
Separated	3	1.23	14	0.81
Unknown	1	0.41	1	0.06
Widowed	0	0.00	4	0.23

Table 4.1 (continued). Characteristics of Women Completing One or Two CTQ

Questionnaires

	Completed 2 CTQs		Completed 1 CTQ	
Age at delivery	Mean=32.7 y	SD=4.5	Mean=33.3 y	SD=5.5
Planned Pregnancy				
No	54	22.41	455	28.78
Yes	187	77.59	1126	71.22
Pregnancy wantedness				
No	5	2.09	67	4.34
Ambivalent	34	14.23	201	13.01
SCID Diagnoses				
Major depression	152	63.07	461	62.13
Depression NOS	4	1.66	8	1.08
Bipolar				
Bipolar I	45	18.91	139	19.04
Bipolar 2	10	4.20	25	3.24
GAD	66	27.39	168	22.64
PTSD	42	17.43	161	21.70
Alcohol dependence	87	36.10	275	37.06
Eating disorders				
Anorexia	14	5.81	41	5.53
Bulimia	11	4.56	51	6.57
Binge eating	11	4.72	51	7.23

*$p<.05$ for difference between participants with one versus two CTQ administrations using chi-square   test;
**$p<.05$ for difference between participants with one versus two CTQ administrations, using Fisher's exact test;
***$p<.01$ for difference between participants with one versus two CTQ administrations, using Fisher's exact test

Table 4.2. Prevalence and Reliability of Individual Traumas

Trauma Subtype (Defined as Any vs. None)	Kappa	PABAK	Observed Agreement (Po)	Expected Agreement (Pe)	Positive Agreement (Ppos)	Negative Agreement (Pneg)	Prevalence Index	Bias Index
Emotional Abuse	0.75 (0.66-0.83)	0.75	0.88	0.51	0.86	0.89	-0.14	0.01
Physical Abuse	0.62 (0.50-0.73)	0.72	0.86	0.64	0.71	0.91	-0.52	-0.01
Sexual Abuse	0.76 (0.67-0.86)	0.83	0.91	0.63	0.82	0.94	-0.52	-0.04
Physical Neglect	0.37 (0.23-0.51)	0.58	0.79	0.66	0.50	0.87	-0.57	-0.02
Emotional Neglect	0.60 (0.50-070)	0.60	0.80	0.50	0.78	0.82	-0.09	0.04

Emotional Abuse

		2nd CTQ		
		N	Y	
1st CTQ	N	123	14	43.62%
	Y	16	90	
		42.80%		243

Physical Abuse

		2nd CTQ		
		N	Y	
1st CTQ	N	169	18	23.36%
	Y	16	41	
		24.18%		244

Sexual Abuse

		2nd CTQ		
		N	Y	
1st CTQ	N	175	15	22.13%
	Y	6	48	
		25.82%		244

Physical Neglect

		2nd CTQ		
		N	Y	
1st CTQ	N	165	28	20.25%
	Y	23	26	
		22.31%		242

Emotional Neglect

		2nd CTQ		
		N	Y	
1st CTQ	N	108	20	47.54%
	Y	29	87	
		43.85%		244

Table 4.2 (continued). Prevalence and Reliability of Individual Traumas

Trauma Subtype (None or Low vs. Moderate or High)	Kappa	PABAK	Observed Agreement (Po)	Expected Agreement (Pe)	Positive Agreement (Ppos)	Negative Agreement (Pneg)	Prevalence Index	Bias Index
Emotional Abuse	0.62 (0.49-0.74)	0.75	0.88	0.68	0.69	0.92	-0.60	-0.01
Physical Abuse	0.65 (0.51-0.80)	0.84	0.92	0.77	0.70	0.96	-0.74	-0.03
Sexual Abuse	0.73 (0.62-0.84)	0.84	0.92	0.71	0.78	0.95	-0.65	-0.03
Physical Neglect	0.52 (0.34-0.70)	0.83	0.92	0.83	0.57	0.95	-0.81	-0.02
Emotional Neglect	0.61 (0.48-0.74)	0.76	0.88	0.70	0.68	0.93	-0.63	-0.01

Emotional Abuse

1st CTQ	2nd CTQ N	2nd CTQ Y	
N	179	16	
Y	14	34	19.75%
		20.58%	243

Physical Abuse

1st CTQ	2nd CTQ N	2nd CTQ Y	
N	203	13	
Y	6	22	11.48%
		14.34%	244

Sexual Abuse

1st CTQ	2nd CTQ N	2nd CTQ Y	
N	192	13	
Y	6	33	15.98%
		18.85%	244

Physical Neglect

1st CTQ	2nd CTQ N	2nd CTQ Y	
N	209	12	
Y	8	13	8.68%
		10.33%	242

Emotional Neglect

1st CTQ	2nd CTQ N	2nd CTQ Y	
N	184	16	
Y	13	31	11.48%
		14.34%	244

CHAPTER 5

An exploratory study of whether pregnancy outcomes influence maternal self-reported history of childhood maltreatment

Abstract

Purpose: Childhood abuse and neglect are common exposures that have been increasingly studied in relation to several health outcomes, including perinatal outcomes. While retrospective self-report is the easiest means to study these relationships in a perinatal epidemiology context, this form of measurement may be prone to bias, particularly recall bias.

Methods: We performed analyses that may help ascertain the role and directionality of bias between exposure to maltreatment and perinatal outcomes in a cohort of women enrolled in perinatal studies of maternal mental illness who were assessed for exposure to childhood maltreatment using the Childhood Trauma Questionnaire at two time points: 1) in the preconception or prenatal period and 2) in the postpartum period.

Results: There was a tendency for women who had an adverse pregnancy outcome to report trauma after delivery but not before; this was not observed among women with healthy pregnancies. Furthermore, estimates of the association of physical neglect with adverse pregnancy outcome measured after delivery were in the opposite direction of estimates derived from before delivery (e.g., for low birth weight, pre-delivery OR=.40 (95% CI: 0.05-3.11) versus post-delivery OR=3.02 (95% CI: 1.00-9.16)).

Conclusions: These findings suggest retrospective maternal reporting of childhood trauma may be prone to systematic differential recall with respect to perinatal outcomes.

However, this effect may be limited to specific maltreatment types, namely physical

neglect.

Introduction

Childhood maltreatment is a common experience (MMWR, 2010). Adult

women have retrospectively self-reported exposure before age 18 to sexual (24.7%),

physical (29.0%), and emotional (13.1%) abuse, and physical (9.2%) and emotional

(16.7%) neglect, respectively (Felitti, 1998). Such childhood exposures have been linked

to distant pathologies, including vulnerability to psychopathology (Heim, 2000), obesity

(Hollingsworth, 2014), chronic pain syndromes (Afari, 2014), and inflammation and

cardiovascular outcomes (Dong, 2004; Rooks, 2012).

Increasingly, investigators have reported associations between adverse maternal

childhood experiences and perinatal and other related outcomes around the time of

pregnancy, including preterm birth, fetal loss, and maternal medical complications during

pregnancy (Hillis, 2004; Leeners, 2010; Noll, 2007). However, null findings also exist

(e.g., Grimstad, 1999; Benedict, 1999; Leeners, 2010). Several studies have also

reported that stress, broadly defined, is associated with preterm birth, and that this

association may be mediated through multiple biological and behavioral mechanisms

(Dole, 2003; reviewed in Wadhwa, 2011). There has been increased interest in

preconception health and life course psychosocial stressors in relation to perinatal

outcomes and this literature is expected to further grow (Kramer, 2011).

One factor which may explain discrepant findings related to childhood exposures

misclassification. Unlike many other exposures, it is difficult to make direct inquiries of

affected children, in part due to the ethics of asking minors about abuse and neglect

(Amaya-Jackson, 2000). Further, measures that utilize reporting of maltreatment to authorities are relatively uncommon and most cases of abuse are not reported (MacMillan, 2009).   There is no agreed upon gold standard measure for child maltreatment, and epidemiologists often rely upon retrospective self-reported measures, in part due to their convenience.   In general, sensitive topics, which also include sexual behaviors, induced abortions, and illicit drug use, are prone to underreporting.   Factors such as the mode of measurement (e.g., written survey versus interview) and fear of repercussions, including reporting to authorities, may influence the extent of underreporting (Tourangeau, 2007).

One way of gaining information about possible bias of these self-reported measures is through measurement of test-retest reliability. Reliability does not guarantee validity, but poor reliability for sensitive topics such as maltreatment suggests selective underreporting since misreporting a non-event is unlikely (MacMillan, 2009).   Not remembering or misinterpreting questions may also lead to non-differential underreporting and poor reliability.   Reliability of retrospective reporting of child abuse and neglect, particularly with validated scales, has generally shown at least moderate consistency (Dube, 2004; Yankura, 2009; Cammack, 2015). However, some measures, such as for physical and sexual abuse for which Fergusson (2000) found kappas of .47 and .45, respectively, and Da Silva (2012) reported kappas ranging from .33 to .43 for various domains of maltreatment on the Childhood History Questionnaire, suggesting less than ideal agreement.

To our knowledge, no studies have examined if reliability is affected by the experience of specific perinatal outcomes.   Factors that influence memory, such as mood

state, are directly influenced by pregnancy and the postpartum periods (Buckwalter, 2001). Women who experience adverse pregnancy outcomes may differentially be susceptible to such factors, thereby affecting the agreement of their reporting of experiences of childhood trauma. Also, mothers who give birth to preterm infants are at increased risk of postpartum depression (Vigod, 2010). While this association may not necessarily be causal, it suggests that pregnancy specific events may be directly related to factors such as mood, which may in turn affect reporting. Further, an anecdotal literature has suggested that pregnancy specific events such as traumatic labor and breastfeeding may affect recall of childhood trauma (Leeners, 2006).

It is plausible that experiencing an adverse pregnancy outcome could lead to increased reporting of abuse, relative to those who have not experienced such an outcome. Recall bias has been observed in some studies of perinatal outcomes (e.g., Boeke, 2012; Drews, 1990; Hogue, 1975). Regarding childhood trauma, a few studies have examined the relationship between a history of maltreatment and health outcomes, comparing the effects of prospective versus retrospective reporting (relative to the outcome of interest). Some of these studies report positive findings only for the retrospective associations (Widom, 1999; Raphael, 2001). Within the perinatal literature, many studies examining the relationship between maternal exposure to child maltreatment and a given perinatal outcome rely on retrospective measures (e.g., Leeners, 2010; Diesel, 2014; Cammack, 2011). These assessments are variable in timing with respect to the outcome of interest, but it is unclear if pre-delivery measured trauma yields systematically different results than postnatally measured trauma.

This study aims to fill knowledge gaps pertaining to the possible bias from timing of the administration of childhood trauma measurement in relation to perinatal outcomes. We assessed whether: 1) the test-retest reliability of childhood trauma reporting differed according to perinatal outcome status; 2) women who discrepantly reported trauma were more likely to report exposure to trauma after (versus before) delivery and whether this discrepant reporting varied according to perinatal outcome status; and 3) associations of childhood trauma with perinatal outcomes measured before delivery were meaningfully different than those measured after delivery.

Methods

Participants were drawn from a convenience sample of pregnant women aged 18–45 at the Emory Women's Mental Health Program (WMHP) enrolled in prospective observational studies of the perinatal course of psychiatric illness. Women were referred to the WMHP by community obstetric or psychiatric care providers. Most participants had lifetime histories of a mood and/or anxiety disorder, and many were receiving psychotropic treatment. All participants provided written informed consent, and study participation was independent of their treatment. This research was approved by the Emory University IRB.

Child Abuse and Neglect Exposures

A retrospective history of childhood trauma was assessed using the Childhood Trauma Questionnaire Short-Form (CTQ; Bernstein and Fink, 1998), which has been

shown to have good internal consistency and validity, as compared to clinical trauma history assessment (Bernstein, 2003; Matthews, 2014; Paivio, 2004). This scale has been extensively used in many populations. Three domains of abuse (sexual, physical, and emotional), and two domains of neglect (physical, emotional) are measured with five questions each, on a 5-point likert scale. In this sample, internal consistency was overall good (subscale Cronbach's alphas .58-.93). We examined dichotomized individual trauma scales according to the authors' recommended cutpoints for no or low versus moderate or severe trauma. We also examined trauma collectively in two ways 1) as a sum of the individual dichotomized traumas and 2) as a median split of the overall CTQ scale. Finally, the CTQ also contains a denial scale used to identify possible underreporting of trauma. We considered the role of denial at either administration versus no denial in sensitivity analyses.

Women completed the initial CTQ prior to conception or during pregnancy (T1 or pre-delivery). Administration of the CTQ was repeated after the completion of the pregnancy (T2 or post-delivery); however, 48 women had conceived again and were pregnant or had completed a subsequent pregnancy prior to the second administration of the CTQ. 12 subjects completed the repeat CTQ administration through the mail and the remainder during a clinic or research visit.

Outcomes

Pregnancy outcomes were ascertained through chart reviews. Outcomes included preterm birth (less than 37 weeks of gestation), low birth weight (less than 2500 grams), and neonatal intensive care unit (NICU) admission. We selected these perinatal outcomes because of their relatively high prevalence, importance to maternal and child health, and frequent use in maternal child health studies. Although low birth weight is a relatively imprecise outcome since it reflects either shortened gestation and/or growth restriction, it is a commonly measured and represents a more severe outcome since near term infants are often normal birth weight. Similarly, NICU admission is also a less precise outcome, but it allows for a broad estimate of health problems in the newborn and is a distinct event that mothers may be more easily able to recall. For the minority of women who had completed more than one pregnancy before the second CTQ, we considered them to have the outcome of interest if they had experienced it at least once.

Analyses

For analyses of test-retest reliability, we computed Cohen's kappas, with 95% confidence intervals, for dichotomized abuse trauma variables. Kappas were interpreted according to guidelines from Landis and Koch (1977) (0 to 0.2, poor; 0.2 to <0.4, fair; 0.4 to <0.6, moderate; 0.6 to <0.8, substantial; and 0.8 to 1.0, almost perfect). Kappas were stratified according to the presence or absence of specific perinatal outcomes.

We next conducted McNemar tests to ascertain any differences in directionality of reporting according to the presence or absence of a given outcome (i.e., whether the number of women who reported a given type of childhood trauma before delivery but not after delivery was different than the number reporting after delivery but not before).

Finally, to compare differences in associations between pre-delivery versus post-delivery measured maltreatment with perinatal outcomes, we used unconditional logistic regression to quantify the association between individual childhood traumas and a given outcome. We also computed the ratio of post-delivery: pre-delivery odds ratios (Cockburn, 2001) and considered a 20% difference between the assessments (i.e., ratios of odds ratios >1.20 and greater) to be meaningfully different. Finally, we stratified these results on the following variables that may affect reporting of trauma: 1) whether the second CTQ visit was more than vs. less than one year postpartum, 2) the presence of denial at either time point, 3) maternal age, and 4) gravidity.

Results

Of 1975 participants who completed at least one CTQ, 247 participants were contacted and completed two CTQ assessments, and information on perinatal outcomes was obtained for 230 women. Among these 230 women, the second CTQ was completed between 23 and 369.9 weeks after the index pregnancy (median time between T1 and T2= 144 weeks; IQR: 82.7, 214.1 weeks). Most participants completed the original questionnaire in the preconception period (median=44.4 weeks before delivery (IQR: 25.6 - 96.3 weeks) and the second questionnaire was completed for most women between three months and three years postpartum (median= 66.4 weeks after delivery; IQR: 35.7-133.5). Women were predominantly white, non-Hispanic, married, and most pregnancies were planned and desired (Table 1). History of childhood trauma was reported by a substantial minority of participants. The majority of women had at least

one previous pregnancy. Approximately one quarter of participants indicated denial at one of the two study time points (N=57; 24.9%). For low birth weight and preterm birth, except for one subject, all low birth weight babies were also preterm.

Table 2 shows the distribution of the CTQ data for both time points for individual trauma types, stratified according to the presence or absence of preterm birth, low birth weight, and NICU admission. Table 3 shows Cohen's kappas associated with these data. Estimates were generally at least moderate except for physical neglect in women who had low birthweight or preterm babies, and for physical abuse in women who had babies admitted to the NICU. Table 4 presents the number of women with discrepant reporting of childhood trauma between the two study visits and the McNemar p-values associated with these values. Women who discrepantly reported maltreatment and also experienced adverse perinatal outcomes were generally more likely to report maltreatment the second time point than the first. However, statistical significance was achieved only among women experiencing low birth weight who discrepantly reported physical neglect (4 versus 0 women, p=.05). Among women who did not experience poor perinatal outcomes, those with discrepant reports were also more likely to report maltreatment at the second assessment. However, the differences were not as marked and none achieved statistical significance, despite having a larger sample size. Moreover, the tendency for discrepant reports of physical neglect to be reported at the second time point was not present.

Table 5 shows the associations (odds ratios) between maltreatment and perinatal outcomes, comparing trauma measured before versus after delivery. It also shows the ratio of the odds ratio of the post-delivery assessment: the odds ratio of the pre-delivery

assessment. For emotional abuse, all perinatal outcomes had larger odds ratios associated with the pre-delivery assessment than the post-delivery assessment (i.e., ratios of odds ratios less than 1). By contrast, all odds ratios for physical neglect measured after delivery were meaningfully greater than before delivery, and for the case of low birth weight and preterm birth, also in a different direction than the pre-delivery estimate (i.e., harmful, instead of protective). Ratios of these odds ratios were consistently above 1.2. Other forms of abuse and neglect tended to have larger post-delivery measured odds ratios, although this was less consistent, and not observed when considering preterm birth as the outcome. Overall trauma sums were substantially higher for trauma measured after delivery when low birth weight was examined as an outcome, but with the exception of physical neglect, this trend was not observed for preterm birth. Although differences in point estimates were often meaningfully significant (i.e., more than a 20% difference, or a ratio of 1.2), confidence intervals were relatively wide and overlapped for most observed differences.

Tables 6a, 6b, 6c, and 6d show these associations stratified on factors that may be related to reporting of abuse (gravidity, whether the woman was less than or more than one year postpartum, presence of denial, and whether the mother was greater than or less than 30 years old at the time of delivery). Among women who had not previously been pregnant at the first CTQ, the ratio of post to pre-delivery odds ratios tended to be higher than in those who had previously been pregnant. Also, among women who reported denial at either time point, there were several instances where all participants who reported a given maltreatment type and also experienced an adverse perinatal outcome only reported maltreatment at the second time point (data not shown). However, these

numbers were very small due to the considerably lower prevalence of all maltreatment types among these women (as compared those who did not exhibit denial (all p<.05)). By contrast, among those women not experiencing denial, differences between pre and post-delivery odds ratios were in most cases close to one, with the exception of physical neglect.

We also conducted sensitivity analyses for the women who were Bipolar type I (N=42) since individuals with this condition may have psychotic symptoms that could more severely affect their ability to recall events. In general, results were similar to the overall study population.

Discussion

To our knowledge, this study is the first to examine repeated measures of self-reported childhood maltreatment history and bias measured around the time of pregnancy in relation to experiences of adverse perinatal outcomes. While most women's reports agreed at the two time periods, women experiencing adverse perinatal outcomes had less agreement in reporting for some maltreatment types than women not experiencing adverse outcomes. Moreover, when examined with the assumption that reports may not only lack agreement but also be systematically directional, we found that women whose responses disagreed were more likely to report trauma after than before delivery. Also, the association between outcomes and trauma measured after delivery tended to be greater than the association with trauma measured before delivery. Taken together, these novel data support the possibility of a systematic recall bias. However, with the

exception of physical neglect, the differences were largely modest and not consistently observed.

There are multiple reasons why women may be more likely to recall maltreatment after delivering a child as compared to before delivery. Pregnancy and parenthood may make women more likely to recognize maltreatment, particularly if maltreatment is subtle, as is often the case for neglect. Further, it may make sense that physical neglect, which was operationalized to include withholding of necessary medical services, may be relatively more susceptible to differential recall: perhaps mothers are more likely to connect previous health issues with current ones.   Many women report feeling a great deal of guilt and responsibility for a poor birth outcome (Barr, 2015) so it further makes sense that these women may be prone to looking for sources of their own perceived poor health that may have resulted in an unhealthy baby. It also makes sense that that differential recall would be more likely among women in their first pregnancy: the initial transition to motherhood may make a woman reflect relatively more about her childhood experiences, as compared to women who had previously been pregnant. Finally, if the women were traumatized by the adverse pregnancy outcome, then perhaps a new trauma may have reactivated memories of an old trauma.

An important limitation was the relatively small sample size of this study. Although we conducted some sensitivity analyses, our small sample size limits their usefulness and ability to draw inferences.   However, any large, systematic differences in reporting by time period and pregnancy outcome should have been seen. The general lack of large differences suggests that if selective recall exists, it may be small but biased away from the null.   Hence, associations between childhood trauma and perinatal

outcomes are possibly more valid when measurement of maltreatment occurs before experiencing perinatal outcomes. However, prospective cohort studies are often only feasible for relatively common perinatal outcomes.

Another important limitation, as we previously noted (Cammack, 2015), is that the study population consisted of relatively homogeneous, upper middle class white women with a history of psychiatric illness who participated in longitudinal studies. The demanding protocol may have yielded highly compliant and motivated women that were more likely to accurately report exposure to maltreatment. Homogeneous populations may result in decreased estimates of agreement since increased precision is needed to distinguish differences; therefore compared to more diverse populations of women, our observed reliability effect sizes may be underestimates.   This is particularly true in our subsample of women who were of even relatively higher socioeconomic status than all women who received at least one CTQ.

It is important to note that in the absence of a gold standard for maltreatment, we cannot truly assess recall bias; rather, our findings are suggestive in nature. However, we contend that small systematic differences in recall between those who experience adverse outcomes versus those with normal pregnancies should elicit concerns for retrospective studies that find only small effects. Future studies, such as those with verified child maltreatment exposures (e.g., Child Protective Services records), may be an important contribution to this literature, although they would introduce biases related to generalizability, given limited reporting of maltreatment (MacMillan, 2003).

In summary, these findings suggest potential systematic recall of childhood trauma, particularly physical neglect, is associated with experiencing an adverse

pregnancy outcome.   It remains important to explore childhood trauma in relation to

perinatal outcomes utilizing a variety of study designs, while remaining cognizant that

retrospective reports obtained after delivery may contribute to bias.

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Table 5.1. Descriptive Characteristics of Women Completing One or Two CTQ Questionnaires

	Women Completing Two CTQs		Women Completing One CTQ	
	N	%	N	%
Age at Delivery				
Childhood Trauma				
T1 Emotional Abuse	45	19.65%	404	23.63%
T2 Emotional Abuse	48	20.87%	N/A	N/A
T1 Physical Abuse	28	12.17%	254	14.91%
T2 Physical Abuse	35	15.22%	N/A	N/A
T1 Sexual Abuse	35	15.22%	357	21.01%
T2 Sexual Abuse	43	18.70%	N/A	N/A
T1 Emotional Neglect	40	17.39%	375	21.99%
T2 Emotional Neglect	43	18.70%	N/A	N/A
T1 Physical Neglect	21	9.13%	233	13.65%
T2 Physical Neglect	22	9.65%	N/A	N/A
Prenatal Outcomes				
Preterm Birth	44	19.13%	161	17.54%
Low Birthweight	24	10.57%	57	10.77%
NICU Admission	28	12.23%	89	15.86%
Education ****				
12 years or less	2	0.87%	151	8.90%
13-15	39	16.96%	360	21.21%
16+	189	82.17%	1186	69.89%

Race **				
Asian	7	3.04%	34	1.96%
Black	12	5.22%	170	9.82%
Native American	0	0.00%	23	1.33%
Multiple Races	3	1.30%	30	1.73%
Unknown	1	0.43%	19	1.10%
Pacific Islander	0	0.00%	1	0.06%
White	207	90.00%	1454	84%
Ethnicity				
Hispanic	5	2.17%	65	3.76%
non-Hispanic	225	97.83%	1666	96.24%
Marital Status ****				
Divorced	5	2.18%	58	3.36%
Married	203	88.65%	1402	81.18%
Never Married, Lives with Partner	11	4.80%	158	9.15%
Never Married, Lives Alone	7	3.06%	90	5.21%
Separated	3	1.31%	14	0.81%
Unknown	1	0.41%	1	0.06%
Widowed	0	0.00%	4	0.23%
Planned Pregnancy*				
No	48	21.33%	455	28.78%
Yes	177	78.67%	1126	71.22%

* p<.05 for difference between participants with one versus two CTQ administrations using chi-square-test

** p <.01 for difference between participants with one versus two CTQ administrations, using Fisher's exact test

*** p <.01 for difference between participants with one versus two CTQ administrations, using chi- square test

**** p <.01 for difference between participants with one versus two CTQ administrations, using Fisher's exact test

Note, columns may not total to 230 (women completing two CTQs) and 1975 (women completing one CTQs) due to missing data).

Table 5.2a. Distributions of Traumas, Stratified by Presence or Absence of PTB

Term Births				Preterm Births			
Emotional Abuse				**Emotional Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	136	15		N	33	0	
Y	9	26	18.82%	Y	3	7	23.26%
		22.04%	186			16.28%	43
Physical Abuse				**Physical Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	152	11		N	37	2	
Y	5	18	12.37%	Y	1	4	11.36%
		15.59%	186			13.64%	44
Sexual Abuse				**Sexual Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	149	10		N	34	2	
Y	3	24	14.52%	Y	1	7	18.18%
		18.28%	186			20.45%	44
Emotional Neglect				**Emotional Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	144	11		N	31	4	
Y	8	23	16.67%	Y	4	5	20.45%
		18.28%	186			20.45%	44
Physical Neglect				**Physical Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	162	6		N	36	4	
Y	7	10	9.19%	Y	1	2	6.98%
		8.65%	185			13.95%	43

Table 5.2b. Distributions of Traumas, Stratified by Presence or Absence of LBW

Normal Birthweight				Low Birth Weight			
Emotional Abuse				**Emotional Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	149	15		N	18	0	
Y	11	27	18.81%	Y	1	5	25.00%
		20.79%	202			20.83%	24
Physical Abuse				**Physical Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	169	10		N	19	2	
Y	5	19	11.82%	Y	1	2	12.50%
		14.29%	203			16.67%	24
Sexual Abuse				**Sexual Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	164	10		N	18	2	
Y	4	25	14.29%	Y	0	4	16.67%
		17.24%	203			25.00%	24
Emotional Neglect				**Emotional Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	156	12		N	18	2	
Y	10	25	17.24%	Y	1	3	16.67%
		18.23%	203			20.83%	24
Physical Neglect				**Physical Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	177	6		N	18	4	
Y	8	11	9.41%	Y	0	1	4.35%
		8.42%	202			21.74%	23

Table 5.2c. Distributions of Traumas, Stratified by NICU Admission

No NICU Admission				NICU Admission			
Emotional Abuse				**Emotional Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	151	13		N	17	2	
Y	9	27	18.00%	Y	3	6	32.14%
		20.00%	200			28.57%	28
Physical Abuse				**Physical Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	169	8		N	20	4	
Y	4	20	11.94%	Y	2	2	14.29%
		13.93%	201			21.43%	28
Sexual Abuse				**Sexual Abuse**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	163	9		N	19	3	
Y	4	25	14.43%	Y	0	6	21.43%
		16.92%	201			32.14%	28
Emotional Neglect				**Emotional Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	156	13		N	18	2	
Y	9	23	15.92%	Y	3	5	28.57%
		17.91%	201			25.00%	28
Physical Neglect				**Physical Neglect**			
	2nd CTQ				2nd CTQ		
1st CTQ	N	Y		1st CTQ	N	Y	
N	178	7		N	19	3	
Y	6	8	7.04%	Y	2	4	21.43%
		7.54%	199			25.00%	28

Table 5.3. Test-Retest Reliability of Individual Childhood Traumas, Stratified by Experiences of

Adverse Perinatal Outcome

Low Birthweight (< 2500 grams)		
Normal Birthweight		Cohen's Kappa (95% CI)
	Emotional Abuse	0.60 (0.45- 0.74)
	Physical Abuse	0.67 (0.52- 0.83)
	Sexual Abuse	0.74 (0.61- 0.87)
	Emotional Neglect	0.63 (0.49- 0.77)
	Physical Neglect	0.57 (0.37- 0.77)
	Median of Total Scale	0.67 (0.57- 0.77)
Low Birthweight		
	Emotional Abuse	0.88 (0.66- 1.00)
	Physical Abuse	0.50 (0.01- 0.99)
	Sexual Abuse	0.75 (0.43- 1.00)
	Emotional Neglect	0.59 (0.18- 1.00)
	Physical Neglect	0.28 (-0.16- 0.73)
	Median of Total Scale	0.74 (0.46- 1.00)
Preterm Birth (<37 weeks GA)		
Term Birth		
	Emotional Abuse	0.60 (0.46- 0.75)
	Physical Abuse	0.64 (0.48- 0.80)
	Sexual Abuse	0.75 (0.62- 0.88)
	Emotional Neglect	0.65 (0.50- 0.79)
	Physical Neglect	0.57 (0.36- 0.78)
	Median of Total Scale	0.68 (0.57- 0.78)
Preterm Birth		
	Emotional Abuse	0.78 (0.55- 1.00)
	Physical Abuse	0.69 (0.36- 1.00)
	Sexual Abuse	0.78 (0.55- 1.00)
	Emotional Neglect	0.44 (0.12- 0.77)
	Physical Neglect	0.39 (-0.03- 0.81)
	Median of Total Scale	0.71 (0.50- 0.93)
No NICU Admission		
	Emotional Abuse	0.64 (0.51- 0.78)
	Physical Abuse	0.74 (0.59- 0.88)
	Sexual Abuse	0.76 (0.63- 0.88)
	Emotional Neglect	0.61 (0.46- 0.76)
	Physical Neglect	0.52 (0.29- 0.75)
	Median of Total Scale	0.68 (0.57- 0.78)

NICU Admission		
	Emotional Abuse	0.58 (0.25- 0.91)
	Physical Abuse	0.28 (-0.15- 0.71)
	Sexual Abuse	0.73 (0.45- 1.00)
	Emotional Neglect	0.55 (0.20- 0.90)
	Physical Neglect	0.50 (0.12- 0.88)
	Median of Total Scale	0.70 (0.43- 0.97)

Table 5.4. Discrepant Reports of Childhood Trauma, Stratified by Experiences of Adverse

Perinatal Outcome Status

		N Reporting Abuse Before Delivery but not After	N Reporting Abuse After Delivery but not Before	McNemar p-value
Low Birthweight (< 2500 grams)				
Normal Birthweight				
	Emotional Abuse	11	15	0.43
	Physical Abuse	5	10	0.20
	Sexual Abuse	4	10	0.11
	Emotional Neglect	10	12	0.67
	Physical Neglect	8	6	0.59
	Median of Total Scale	16	17	0.86
Low Birthweight				
	Emotional Abuse	1	0	0.32
	Physical Abuse	1	2	0.56
	Sexual Abuse	0	2	0.16
	Emotional Neglect	1	2	0.56
	Physical Neglect	0	4	0.05
	Median of Total Scale	1	2	0.56
Preterm Birth (<37 weeks GA)				
Term Birth				
	Emotional Abuse	9	15	0.22
	Physical Abuse	5	11	0.13
	Sexual Abuse	3	10	0.05
	Emotional Neglect	8	11	0.49
	Physical Neglect	7	6	0.78
	Median of Total Scale	15	15	1.00
Preterm Birth				
	Emotional Abuse	3	0	0.08
	Physical Abuse	1	2	0.56
	Sexual Abuse	1	2	0.56
	Emotional Neglect	4	4	1.00
	Physical Neglect	1	4	0.18
	Median of Total Scale	2	4	0.41

No NICU Admission				
	Emotional Abuse	9	13	0.39
	Physical Abuse	4	8	0.25
	Sexual Abuse	4	9	0.17
	Emotional Neglect	9	13	0.39
	Physical Neglect	6	7	0.78
	Median of Total Scale	15	17	0.72
NICU Admission				
	Emotional Abuse	3	2	0.65
	Physical Abuse	2	4	0.41
	Sexual Abuse	0	3	0.08
	Emotional Neglect	3	2	0.65
	Physical Neglect	2	3	0.65
	Median of Total Scale	2	2	1.00

Table 5.5. Associations of Maternal Exposure to Abuse and Neglect Measured Before vs. After

Delivery with Perinatal Outcomes

		Pre-Delivery Measured OR (95% CI)	Post-Delivery Measured OR (95% CI)	Ratio of Post-Delivery / Pre Delivery Odds Ratio
	Trauma Subtype			
Preterm Birth				
	Emotional Abuse	1.31 (0.59-2.90)	0.67 (0.28-1.61)	0.51
	Physical Abuse	0.91 (0.33-2.54)	0.86 (0.33-2.21)	0.95
	Sexual Abuse	1.31 (0.55-3.12)	1.11 (0.53-2.33)	0.85
	Emotional Neglect	1.29 (0.56-2.94)	1.15 (0.51-2.61)	0.89
	Physical Neglect	0.68 (0.19-2.43)	1.71 (0.63-4.67)	2.51
	Sum of Traumas	1.06 (0.82-1.38)	1.03 (0.79-1.35)	0.97
Low Birthweight				
	Emotional Abuse	2.34 (1.14-4.84)	1.01 (0.36-2.86)	0.43
	Physical Abuse	1.07 (0.30-3.84)	1.20 (0.38-3.76)	1.12
	Sexual Abuse	1.20 (0.38-3.76)	1.60 (0.59-4.32)	1.33
	Emotional Neglect	0.96 (0.31-2.98)	1.18 (0.41-3.37)	1.23
	Physical Neglect	0.40 (0.05-3.11)	3.02 (1.00-9.16)	7.55
	Sum of Traumas	1.02 (0.72-1.44)	1.21 (0.88-1.66)	1.19
NICU Admission				
	Emotional Abuse	2.16 (0.90-5.16)	1.61 (0.66-3.92)	0.75
	Physical Abuse	1.23 (0.39-3.85)	1.69 (0.63-4.52)	1.37
	Sexual Abuse	1.62 (0.60-4.33)	2.33 (0.97-5.58)	1.44
	Emotional Neglect	2.11 (0.86-5.21)	1.53 (0.60-3.87)	0.73
	Physical Neglect	3.38 (1.19-9.62)	4.09 (1.50-11.17)	1.21
	Sum of Traumas	1.32 (1.00-1.74)	1.38 (1.04-1.81)	1.05

Table 5.6a. Associations of Maternal Exposure to Abuse and Neglect Measured Before vs. After

Delivery with Perinatal Outcomes: Stratified on Timing of Second CTQ

		2nd CTQ Less Than One Year Post-Partum			2nd CTQ More Than One Year Post-Partum		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
PTB							
	Emotional Abuse	0.65 (0.13 - 3.17)	0.32 (0.07 - 1.53)	0.49	1.76 (0.68 - 4.56)	1.16 (0.39 - 3.49)	0.66
	Physical Abuse	None exposed have outcome	0.37 (0.04 - 3.04)	Infinity	1.92 (0.61 - 6.06)	1.16 (0.39 - 3.49)	0.60
	Sexual Abuse	0.87 (0.17 - 4.37)	1.52 (0.43 - 5.43)	1.75	1.57 (0.55 - 4.47)	0.96 (0.32 - 2.82)	0.61
	Emotional Neglect	0.87 (0.17 - 4.37)	0.71 (0.15 - 3.53)	0.82	1.47 (0.55 - 3.92)	1.38 (0.52 - 3.68)	0.94
	Physical Neglect	None exposed have outcome	0.73 (0.08 - 6.36)	Infinity	1.06 (0.27 - 4.08)	2.37 (0.73 - 7.73)	2.24
	Sum of Traumas	0.73 (0.40 - 1.36)	0.85 (0.52 - 1.39)	1.16	1.19 (0.88 - 1.61)	1.15 (0.83 - 1.60)	0.97

Table 5.6a Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Stratified on Timing of Second CTQ

		2nd CTQ Less Than One Year Post-Partum			2nd CTQ More Than One Year Post – Partum		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
LBW							
	Emotional Abuse	0.62 (0.07 - 5.37)	0.35 (0.04 - 2.98)	0.56	1.96 (0.62 - 6.23)	1.96 (0.57 - 6.80)	1.00
	Physical Abuse	None exposed have outcome	0.88 (0.10 - 7.81)	Infinity	2.02 (0.50 - 8.11)	1.36 (0.35 - 5.27)	0.67
	Sexual Abuse	1.58 (0.29 - 8.59)	2.84 (0.61 - 13.20)	1.8	1.11 (0.33 - 3.73)	1.12 (0.29 - 4.29)	1.01
	Emotional Neglect	0.88 (0.10 - 7.81)	1.87 (0.34 - 10.30)	2.13	0.94 (0.25 - 3.59)	0.89 (0.24 - 3.39)	0.95
	Physical Neglect	None exposed have outcome	1.88 (0.20 - 17.91)	Infinity	0.53 (0.07 - 4.38)	3.53 (0.96 - 13.02)	6.66
	Sum of Traumas	0.72 (0.31 - 1.69)	1.19 (0.69 - 2.05)	1.65	1.12 (0.77 - 1.63)	1.24 (0.84 - 1.83)	1.11

Table 5.6a Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Stratified on Timing of Second CTQ

		2nd CTQ Less Than One Year Post-Partum			2nd CTQ More Than One Year Post-Partum		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
NICU Admis-sion							
	Emotional Abuse	0.65 (0.13 - 3.17)	0.32 (0.07 - 1.53)	0.49	1.76 (0.68 - 4.56)	1.16 (0.39 - 3.49)	0.66
	Physical Abuse	None exposed have outcome	0.37 (0.04 - 3.04)	Infinity	1.92 (0.61 - 6.06)	1.16 (0.39 - 3.49)	0.60
	Sexual Abuse	0.87 (0.17 - 4.37)	1.52 (0.43 - 5.43)	1.75	1.57 (0.55 - 4.47)	0.96 (0.32 - 2.82)	0.61
	Emotional Neglect	0.87 (0.17 - 4.37)	0.71 (0.15 - 3.53)	0.82	1.47 (0.55 - 3.92)	1.38 (0.52 - 3.68)	0.94
	Physical Neglect	None exposed have outcome	0.73 (0.08 - 6.36)	Infinity	1.06 (0.27 - 4.08)	2.37 (0.73 - 7.73)	2.24
	Sum of Traumas	0.73 (0.40 - 1.36)	0.85 0.52 - 1.39)	1.16	1.19 (0.88 - 1.61)	1.15 (0.83 - 1.60)	0.97

Table 5.6b. Associations of Maternal Exposure to Abuse and Neglect Measured Before vs. After

Delivery with Perinatal Outcomes: Stratified on Age

		Age ≤30			Age >30		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
PTB							
	Emotional Abuse	0.74 (0.08 - 6.70)	0.36 (0.04 - 3.10)	0.49	1.45 (0.60 - 3.51)	0.78 (0.29 - 2.07)	0.54
	Physical Abuse	0.74 (0.08 - 6.70)	0.62 (0.07 - 5.52)	0.84	0.96 (0.30 - 3.08)	0.92 (0.32 - 2.65)	0.96
	Sexual Abuse	None exposed have outcome	None exposed have outcome	0.00	1.98 (0.77 - 5.07)	1.59 (0.66 - 3.86)	0.80
	Emotional Neglect	0.90 (0.10 - 8.42)	0.53 (0.06 - 4.66)	0.59	1.35 (0.54 - 3.37)	1.35 (0.54 - 3.37)	1.00
	Physical Neglect	None exposed have outcome	1.25 (0.13 - 12.28)	Infinity	1.03 (0.27 - 3.89)	1.83 (0.59 - 5.64)	1.78
	Sum of Traumas	0.67 (0.27 - 1.64)	0.62 (0.25 - 1.54)	0.93	1.16 (0.86 - 1.56)	1.10 (0.83 - 1.47)	0.95

Table 5.6b Continued. Associations of Maternal Exposure to Abuse and Neglect Measured
Before vs. After Delivery with Perinatal Outcomes: Stratified on Age

		Age ≤30			Age >30		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
LBW							
	Emotional Abuse	None exposed have outcome	None exposed have outcome	0.00	2.34 (0.78 - 7.09)	1.85 (0.59 - 5.82)	0.79
	Physical Abuse	1.17 (0.12 - 10.99)	1.17 (0.12 - 10.99)	1.00	1.05 (0.22 - 5.05)	1.28 (0.34 - 4.91)	1.22
	Sexual Abuse	None exposed have outcome	None exposed have outcome	0.00	2.08 (0.61 - 7.14)	2.82 (0.92 - 8.58)	1.36
	Emotional Neglect	None exposed have outcome	0.84 (0.09 - 7.67)	Infinity	1.41 (0.42 - 4.73)	1.41 (0.42 - 4.73)	1.00
	Physical Neglect	None exposed have outcome	2.07 (0.20 - 21.24)	Infinity	0.65 (0.08 - 5.31)	3.55 (0.99 - 12.76)	5.46
	Sum of Traumas	0.40 (0.07 - 2.29)	0.71 (0.26 - 1.94)	1.77	1.20 (0.82 - 1.75)	1.36 (0.96 - 1.93)	1.13

Table 5.6b Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Stratified on Age

		Age ≤30			Age >30		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
NICU Admis-sion							
	Emotional Abuse	1.61 (0.17 - 15.72)	None exposed have outcome	0.00	2.17 (0.83 - 5.73)	2.40 (0.91 - 6.34)	1.11
	Physical Abuse	None exposed have outcome	1.61 (0.17 - 15.72)	Infinity	1.66 (0.50 - 5.52)	1.63 (0.54 - 4.92)	0.98
	Sexual Abuse	None exposed have outcome	None exposed have outcome	0.00	2.21 (0.77 - 6.34)	3.20 (1.22 - 8.40)	1.45
	Emotional Neglect	1.97 (0.20 - 19.72)	None exposed have outcome	0.00	2.04 (0.75 - 5.54)	2.04 (0.75 - 5.54)	1.00
	Physical Neglect	1.97 (0.20 - 19.72)	2.46 (0.24 - 25.70)	1.25	3.97 (1.20 - 13.08)	4.55 (1.47 - 14.07)	1.15
	Sum of Traumas	0.95 (0.43 - 2.10)	0.58 (0.17 - 2.00)	0.61	1.41 (1.03 - 1.93)	1.51 (1.11 - 2.05)	1.07

Table 5.6c. Associations of Maternal Exposure to Abuse and Neglect Measured Before vs. After

Delivery with Perinatal Outcomes: Stratified on Gravidity

		Nulli-gravid			Gravid		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
PTB							
	Emotional Abuse	1.58 (0.35 - 7.19)	1.06 (0.24 - 4.62)	0.67	1.22 (0.48 - 3.13)	0.52 (0.17 - 1.61)	0.43
	Physical Abuse	0.51 (0.06 - 4.57)	1.06 (0.24 - 4.62)	2.08	1.11 (0.34 - 3.57)	0.70 (0.19 - 2.54)	0.63
	Sexual Abuse	2.22 (0.47 - 10.61)	3.98 (0.98 - 16.16)	1.79	1.05 (0.36 - 3.03)	0.60 (0.19 - 1.85)	0.57
	Emotional Neglect	1.58 (0.35 - 7.19)	1.80 (0.45 - 7.23)	1.14	1.17 (0.44 - 3.17)	0.90 (0.31 - 2.56)	0.77
	Physical Neglect	0.61 (0.07 - 5.58)	1.33 (0.23 - 7.63)	2.18	0.71 (0.15 - 3.35)	1.91 (0.56 - 6.55)	2.69
	Sum of Traumas	1.10 (0.68 - 1.78)	1.25 (0.80 - 1.95)	1.14	1.05 (0.76 - 1.43)	0.92 (0.64 - 1.31)	0.88

Table 5.6c Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Stratified on Gravidity

		Nulli-gravid			Gravid		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
LBW							
	Emotional Abuse	1.63 (0.28 - 9.56)	1.09 (0.19 - 6.20)	0.67	1.39 (0.42 - 4.61)	0.93 (0.25 - 3.47)	0.67
	Physical Abuse	None exposed have outcome	1.23 (0.22 - 7.07)	Infinity	1.89 (0.49 - 7.30)	1.03 (0.22 - 4.89)	0.54
	Sexual Abuse	0.98 (0.10 - 9.39)	3.43 (0.66 - 17.70)	3.5	1.34 (0.35 - 5.05)	1.06 (0.28 - 3.95)	0.79
	Emotional Neglect	1.63 (0.28 - 9.56)	2.22 (0.45 - 10.92)	1.36	0.68 (0.15 - 3.18)	0.68 (0.15 - 3.18)	1.00
	Physical Neglect	0.98 (0.10 - 9.39)	2.28 (0.37 - 13.99)	2.33	None exposed have outcome	3.27 (0.80 - 13.35)	Infinity
	Sum of Traumas	1.00 (0.55 - 1.84)	1.33 (0.80 - 2.23)	1.33	1.02 (0.67 - 1.56)	1.10 (0.72 - 1.68)	1.08

Table 5.6c Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Stratified on Gravidity

		Nulli-gravid			Gravid		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
NICU Admis-sion							
	Emotional Abuse	3.81 (0.85 - 17.05)	2.47 (0.58 - 10.47)	0.65	1.65 (0.54 - 4.98)	1.18 (0.36 - 3.85)	0.72
	Physical Abuse	0.64 (0.07 - 5.83)	0.82 (0.15 - 4.44)	1.28	1.61 (0.42 - 6.14)	2. (0.68 - 7.80)	1.43
	Sexual Abuse	2.93 (0.59 - 14.52)	5.71 (1.31 - 25.03)	1.95	1.14 (0.31 - 4.25)	1.34 (0.41 - 4.40)	1.18
	Emotional Neglect	3.81 (0.85 - 17.05)	2.47 (0.58 - 10.47)	0.65	1.47 (0.45 - 4.85)	0.99 (0.27 - 3.65)	0.67
	Physical Neglect	4.61 (0.84 - 25.14)	7.17 (1.41 - 36.51)	1.56	2.60 (0.65 - 10.37)	2.56 (0.64 - 10.22)	0.98
	Sum of Traumas	1.55 (0.96 - 2.49)	1.62 (1.01 - 2.59)	1.05	1.21 (0.85 - 1.73)	1.21 (0.84 - 1.75)	1.00

Table 5.6d. Associations of Maternal Exposure to Abuse and Neglect Measured Before vs. After Delivery with Perinatal Outcomes: Presence or Absence of Denial

		No Denial			Denial		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
PTB							
	Emotional Abuse	1.45 (0.63 - 3.37)	0.67 (0.27 - 1.66)	0.46	None exposed have outcome	None exposed have outcome	0.00
	Physical Abuse	1.00 (0.35 - 2.89)	0.78 (0.27 - 2.20)	0.78	None exposed have outcome	2.20 (0.18 - 26.71)	Infinity
	Sexual Abuse	1.01 (0.38 - 2.71)	0.74 (0.28 - 1.96)	0.73	4.89 (0.61 - 39.41)	8.25 (1.18 - 57.49)	1.69
	Emotional Neglect	1.16 (0.48 - 2.84)	0.99 (0.41 - 2.40)	0.85	4.50 (0.26 - 78.20)	All exposed have outcome	Infinity
	Physical Neglect	0.72 (0.20 - 2.61)	1.41 (0.48 - 4.19)	1.96	None exposed have outcome	All exposed have outcome	Infinity
	Sum of Traumas	1.04 (0.78 - 1.39)	0.96 (0.71 - 1.29)	0.92	1.22 (0.50 - 3.01)	2.35 (0.83 - 6.64)	1.93

Table 5.6d Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Presence or Absence of Denial

		No Denial			Denial		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del./ Pre Del. Odds Ratio
	Trauma Subtype						
LBW							
	Emotional Abuse	1.52 (0.54 - 4.29)	0.95 (0.32 - 2.80)	0.63	None exposed have outcome	None exposed have outcome	0.00
	Physical Abuse	1.09 (0.29 - 4.06)	0.89 (0.24 - 3.29)	0.82	None exposed have outcome	6.25 (0.46 - 84.79)	Infinity
	Sexual Abuse	1.33 (0.41 - 4.36)	0.98 (0.31 - 3.17)	0.74	None exposed have outcome	10.89 (1.29 - 92.13)	Infinity
	Emotional Neglect	0.95 (0.29 - 3.04)	0.81 (0.25 - 2.61)	0.85	None exposed have outcome	All exposed have outcome	Infinity
	Physical Neglect	0.38 (0.05 - 3.04)	2.22 (0.66 - 7.52)	5.84	None exposed have outcome	All exposed have outcome	Infinity
	Sum of Traumas	1.03 (0.72 - 1.48)	1.07 (0.74 - 1.54)	1.04	None exposed have outcome	3.12 (0.99 - 9.90)	Infinity

Table 5.6d Continued. Associations of Maternal Exposure to Abuse and Neglect Measured

Before vs. After Delivery with Perinatal Outcomes: Presence or Absence of Denial

		No Denial			Denial		
		Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del. /Pre Del. Odds Ratio	Pre-Del. Meas. Crude OR (95% CI)	Post-Del. Meas. Crude OR (95% CI)	Ratio of Post Del. /Pre Del. Odds Ratio
	Trauma Subtype						
NICU Admis-sion							
	Emotional Abuse	2.10 (0.80 - 5.48)	1.75 (0.68 - 4.54)	0.83	3.92 (0.31 - 49.98)	None exposed have outcome	0.00
	Physical Abuse	1.37 (0.42 - 4.45)	1.56 (0.52 - 4.66)	1.14	None exposed have outcome	0.31 (51.03 - 0.00)	Infinity
	Sexual Abuse	1.07 (0.33 - 3.44)	1.11 (0.38 - 3.25)	1.04	9.60 (1.10 - 83.71)	65.33 (5.46 - 781.79)	6.81
	Emotional Neglect	2.46 (0.94 - 6.48)	1.27 (0.46 - 3.51)	0.52	None exposed have outcome	All exposed have outcome	Infinity
	Physical Neglect	2.81 (0.90 - 8.77)	3.55 (1.20 - 10.52)	1.26	All exposed have outcome	All exposed have outcome	Infinity
	Sum of Traumas	1.30 (0.96 - 1.77)	1.27 (0.93 - 1.74)	0.98	1.83 (0.78 - 4.34)	5.81 (1.21 - 28.00)	3.17

CHAPTER 6

The Association Between Maternal Exposure to Child Abuse, Preterm Birth, and

Very Preterm Birth in Nulliparous Women

Abstract

Preterm birth (PTB <37 weeks gestation) and very preterm birth (vPTB <34 weeks' gestation) are leading causes of infant mortality and morbidity. Prior studies have examined the relationship between maternal exposure to childhood abuse and preterm birth. This study expanded on prior work by examining the relationship between retrospectively self-reported maternal history of parent/adult caregiver emotional, physical, and sexual abuse and non-parental/adult caregiver sexual abuse with history of PTB and vPTB among 4,181 nulliparous women with singleton pregnancies from Wave IV of the National Longitudinal Study of Adolescent to Adult Health (mean age at time of delivery= 21.68 yrs). Results showed most findings were null, with the exception of non-parental caregiver sexual abuse motivated by physical threat, which was associated with very preterm birth (aOR= 1.89 (95% CI: (1.07 , 3.32)). This association was limited to women whose abuse had an onset after age 9 (aOR= 1.92 (95% CI: 0.99, 3.74). Future studies should examine this relationship in populations that are older and less resilient, as well examine additional forms of childhood maltreatment, including neglect.

Introduction

Preterm birth (PTB) is the leading cause of infant mortality and morbidity in the United States and is arguably considered the most important problem in maternal and child health. Risks of subsequent morbidity and mortality are even stronger for early preterm birth (vPTB). Although several risk factors have been identified, most are only weakly associated with PTB and vPTB (Blencowe, 2013).

Psychosocial stress is a risk factor for adverse perinatal outcomes, including PTB and vPTB (Dunkel Schetter, 2011; Hogue, 2005; Kramer, 2011). Several studies report small, but positive associations between various types of stressors and PTB. It has been proposed that stressors of a chronic nature with an onset in early life may exert relatively stronger effects (Cammack, 2011), yet many investigations of stress as a risk factor for PTB and vPTB do not specifically focus on the role of chronic stress.

Child abuse, conceptualized as sexual, physical, or emotional abuse, is a common type of chronic stress. Prevalences for these three individual abuse types typically range from 15-30% of women (Felitti, 1998; MMWR, 2010). It has been linked to several outcomes throughout the lifecourse, including, but not limited to, vulnerability to psychopathology (Heim, 2000), obesity (Hollingsworth, 2012), chronic pain syndromes (Afari, 2014), and inflammation and cardiovascular outcomes (Dong, 2004; Rooks, 2012). Maternal exposure to child abuse has also been linked to several behavioral and psychosocial factors specifically during pregnancy that are associated with preterm birth, such as smoking (Chung, 2008), post- traumatic stress disorder (Yonkers, 2014), and depression (Wosu, 2015). It has also been associated with biological factors that are

associated with PTB, such as infection/inflammation (Cammack, 2011; Nemeroff, 2016) and dysregulation of the HPA axis (Horan, 2000; Moog, 2015).

A small number of studies have specifically examined the association between preterm birth and adverse childhood experiences, broadly defined.   Seven of these studies specifically include child abuse in their exposure assessment (Benedict, 1999; Grimstad, 1999; Leeners, 2010; Margerison-Zilko, 2016; Noll, 2007; Selk, 2016; Stevens-Simon, 1994), and five of these studies offer support for the presence of an association.   An additional study found that living in foster care, which is correlated with child maltreatment since that is a primary reason for foster care placement, was associated with preterm birth (Bublitz, 2014).   Finally, another study found a relationship between the total score on the Adverse Childhood Experiences Scale and PTB, but did not examine relationships with individual abuse types specifically and PTB (Christiaens, 2015).

There are several weaknesses in the above mentioned studies.   First, except recent studies (Margerison-Zilko, 2016; Selk, 2016) sample sizes were small, and none of these studies were nationally representative, population based samples.   Also, consideration of vPTB, a more severe outcome, is a feature of only one of these studies (Margerison-Zilko, 2016). Third, none of the studies utilized measures of abuse that assessed the relationship between perpetrator and victim.   While several studies report associations between dating violence in adults and preterm birth, there are only a limited number studies that have specifically looked at the effects of dating violence in adolescents in relation to subsequent birth outcomes (Covington, 2001; Madkour, 2013) and such studies generally do not also include data on family based violence

simultaneously.   Finally, only two of the studies (Margerison-Zilko, 2016; Selk, 2016) specifically considered the role of timing of abuse. Evidence from the developmental literature suggests that timing of exposure to abuse may be an important determinant of its effects on outcomes (Wachs, 2014), so this is an important limitation.

Racial disparities have been widely reported for both preterm birth and very preterm birth. African American women have approximately a 1.5 to two fold risk of preterm birth and a 2 to three fold risk of very preterm birth, relative to non-Hispanic white women (Kramer, 2009). Limited evidence suggests that child abuse may be more common in African American women (Hillis, 2004; MMWR, 2010). Thus, it is plausible that child abuse could, in part, account for the increased suspectibility to PTB and vPTB in African American women.

This study examined exposure to childhood abuse (sexual, physical, verbal) perpetrated by parents/adult caregivers and sexual abuse perpetrated by others in a nationally representative, population based sample. The goals were threefold: to 1) examine the association between maternal child abuse with preterm birth (PTB) and very preterm birth (vPTB); 2) to determine if any observed associations differed by race/ethnicity; and 3) to assess the role of timing of the onset of abuse in any observed associations.

Methods

Study Population

The National Longitudinal Study of Adolescent to Adult Health ("Add Health") (Harris, 2009) interviewed over 90,000 adolescents in grades 7 through 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 to 32 in 2008-2009; (n=15,701; response rate= 80.3%), when they were queried about history of childhood abuse. Inclusion criteria for this study were as follows: 1) presence of a Wave IV sampling weight; 2) data on any of the childhood abuse questions in Wave IV, 3) singleton pregnancy, 4) first live birth (N= 4,181). Permission to conduct secondary analyses was approved by the Emory University IRB.

Exposure Assessment

Abuse history was assessed via five questions. Three questions assessed 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, 2009; Briere, 2003; Crowley, 2003; Straus, 1998). Parental/adult caregiver emotional abuse, physical, and sexual abuse was asked as: "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?", respectively. 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 an affirmative response to a question, participants were subsequently 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, selecting cut points that yield prevalences approximating those found in the Adverse Childhood Experiences questionnaire administered to a multi-state, population based sample. (MMWR, 2010). For these data, the cutpoints were 1 or more total times for sexual abuse (both parental/adult caregiver and non-parental/adult caregiver subtypes), 2 or more times for physical abuse, and 3 or more times for emotional abuse. Since existing literature on time periods of vulnerability is very limited and the distributions appeared to substantially differ for each abuse type, timing of first abuse was considered by dividing age of abuse onset into quartiles, based on the distributions for each individual abuse exposure and comparing abuse exposures in the individual quartiles to individuals with no abuse history. For these data, the 25th, 50th, and 75th percentiles were as follows: parental/caregiver emotional abuse: 6.2, 10.0, 13.3, physical abuse: 6.1, 9.6, 13.1, sexual abuse: 4.4, 7.4, 10.2; non-parental/adult caregiver sexual abuse motivated by non-physical threat: 9.8, 13.6, 15.5, and physical threat 8.6, 13.1, 15.3, respectively.

Outcome Measures

Preterm birth was defined as delivery of a live born infant at less <37 weeks gestation and very preterm birth was defined as <34 weeks gestation. Very preterm birth is variably defined and due to our relatively small number of preterm births, we chose a cutpoint that maximized our statistical power. Preterm delivery was obtained via participant self-reports. Studies have shown that such self-report has good validity when compared to preterm delivery ascertained through medical chart review (Tomeo, 1999).

Statistical Analyses

First, variables were assessed for normality (where appropriate) and plausibility. Associations between child abuse and PTB and vPTB, were examined via chi-squared tests. The relationship between maternal exposure to abuse and PTB and vPTB were modeled via unconditional logistic regression. In addition to crude models, we ran models adjusted for race and participant reported childhood socioeconomic status (highest level of education in a household). The adjusted model did not include other variables such marital status because those variables are likely intermediates in the causal pathways between abuse and PTB, rather than true confounders (See Directed Acyclic Graph in Figure 1). Even though the response rate parental education was high (94%), non-response was associated with exposure to abuse. Thus, for our primary analysis, we used PROC HOTDECK to impute missing responses for this variable (30 imputations). We also stratified the relationships between abuse and PTB/vPTB by race.

Collinearity was assessed by examining correlations between the covariates using a spearman correlation matrix. We considered correlations greater than >.7 an indication of a collinearity problem. All analyses incorporated complex weighting to account for the survey design using SAS callable SUDAAN following guidelines by Chen and Chantala (2014).

Sensitivity Analyses

Small numbers of women reported abuse after delivery, and we excluded them in sensitivity analyses. Because there were relatively few of these women (N for parent/caregiver emotional, physical, and sexual abuse= 9, 2, 0, respectively, and N for non-parent/caregiver sexual abuse motivated by non-physical threats and physical force=83, 59, respectively) and recall of timing of abuse may be subject to error, we ran this as a sensitivity analysis rather than initial exclusion criterion. We also conducted sensitivity analyses excluding women who delivered within the first 3 years after menarche, since young gynecologic age is a known risk factor for preterm birth (Gibbs, 2012) and may be related to abuse exposure. Finally, we conducted sensitivity analyses that excluded women who delivered between 37 to 38 weeks of gestation, to account for possible misclassification of gestational age.

Results

4,181 nulliparous women gave birth to a singleton infant. Table 1 shows descriptive characteristics of this sample. Most women were in their early 20s, white,

unmarried, had at least a high school degree, and were non-smoking. A substantial minority of participants experienced each of the different types of abuse. The prevalence of preterm birth was similar to other reports in the literature (Martin, 2014).

Table 2 shows the bivariate relationships between covariates/potential confounders and preterm birth. Preterm birth was significantly more common among women who were younger, among those not married to the baby's father, and with a high school diploma or less.

Table 3 shows the relationship between the different types of abuse and PTB and vPTB. There was a statistically significant association between sexual abuse perpetrated by non-parental caregivers motivated by threats of physical force and vPTB. This association persisted in models adjusted for race/ethnicity and childhood SES. Adjustment for marital status, adult SES, education, smoking, and age tended to move associations further from the null (data not shown), suggesting these factors did not act as mediators. Results were generally similar to models that did not impute missing values for childhood SES, although the association between sexual abuse perpetrated by non-parental caregivers motivated by physical force and vPTB was no longer significant (aOR= 1.62 (95% CI: 0.89, 2.95)) in models that did not use imputation.

Table 4 shows the crude associations between the types of abuse and PTB and vPTB, stratifying exposure to abuse according to age of abuse onset. Results showed that the association between sexual abuse perpetrated by non-parental/adult caregivers that was motivated by physical force and vPTB was limited to abuse that did not in the first quartile of the age of onset distribution, which corresponds to abuse occurring after about age 9. No other obvious trends for timing of abuse were observed.

Table 5 shows the relationships between the different types of abuse and PTB and vPTB, stratified by race. Results showed that the odds ratios for associations with vPTB in Black women were generally smaller than in other groups. By contrast, results for Hispanic women were generally larger in other groups inconsistent, with the exception of parental/caregiver sexual abuse. However, observed differences were not statistically significant.

Sensitivity analyses revealed that excluding women who delivered between 37-38 weeks had little impact on point estimates (data not shown). Also, excluding women who had menarche within 3 years of delivery and women who reported abuse onset occurring after delivery did not affect results.

Discussion

These data show that exposure to non-parental/caregiver sexual abuse, particularly sexual abuse motivated by physical threat is associated with very preterm birth. These findings may suggest a possible association between child abuse and preterm birth, but this association may be limited to specific populations and types of abuse. Alternatively, it is possible this single finding was observed due to random error.

Our largely null findings ran contrary to our hypothesis. One possible explanation lies in the fact that exposure to trauma does not necessarily result in negative consequences. Individuals may be resilient, as has been documented for child abuse in relation to mental health outcomes (Afifi, 2016) and some may also experience post-

traumatic growth as a result of trauma exposures (Kaye-Tzadok, 2016), which may explain why some of our findings trended towards protective associations and in some cases (e.g. the association between parent/caregiver sexual abuse and vPTB in Hispanic women) were statistically significant. The Add Health study population may have favored women who were either resilient to trauma or experienced posttraumatic growth since selection into the study was contingent upon school enrollment (i.e., survivors had stayed enrolled in school despite their traumatic experiences).

It is also important to consider the younger age of our study population. Studies supporting the weathering hypothesis have shown that among African Americans, increased risk for preterm birth is driven by stronger disparities among older women (Holzman, 2009). The chronic stress of abuse has similarities to stress experienced by African American women (e.g., discrimination). Hence, it is plausible that effects of abuse on birth outcomes are more apparent among older mothers and are therefore not apparent in our relatively young study population.

There are a few reasons why non-parental/caregiver sexual abuse may have a relatively stronger relationship with vPTB/PTB, as compared to other types of abuse. Some studies have shown that sexual abuse has a relatively stronger impact on perinatal outcomes compared to other types of adversity (Cammack, 2011; Margerison-Zilko, 2016; Selk, 2016). Regarding these data, we note that non-caregiver-sexual abuse occurred at a significantly later age than other types of abuse and was closer in timing to delivery. Unfortunately, it is not possible to more clearly discern the relationship between the perpetrator and victim. However, given that the association was limited to abuse that occurred in later childhood and the teenage years, it is plausible that much of it

occurs in the context of dating violence. While there is a large body of evidence that parent/caregiver abuse leads to long term psychological and physiological consequences, dating violence is often a consequence of exposure to adverse childhood experiences (Werner, 2016). One interpretation of this is that dating violence may be a marker of maladaptive coping mechanisms in response to adverse childhood experiences, and that adoption of maladaptive responses to trauma is what drives the increased risk for PTB/vPTB.

Although differences in associations between different racial/ethnic groups were not statistically significant, they merit discussion. Some of our smaller effect sizes among African American women may be explained by their relatively higher levels of baseline stressors. In addition to increased rates of stressors such as poverty, African American women experience race specific stressors, particularly racial discrimination. Some investigators have noted that cumulative effects of stress may hit a plateau and yield blunted responses (e.g., Ouellet-Morin, 2011), which may explain smaller effects of child abuse in a population where unexposed women experience high levels of other stressors. Other investigations have also found that the child abuse-preterm delivery relationship was attenuated in African American women (Margerison-Zilko, 2016). It is also worth noting that reporting of abuse may also vary by race due to cultureal differences. Some studies suggest that Latina women may be likely to underreport sexual assault (Lira, 1999; Rennison, 2007). If Hispanics only consider more extreme exposures abusive, that could explain our findings of stronger effects among Latina women experiencing non-parental caregiver/sexual abuse.

It is possible recall bias may contribute to our findings since information on abuse was collected after delivery. While studies of recall bias of abuse are limited in the context of perinatal outcomes, other studies have suggested it may be an important consideration in studies of other outcomes such as chronic pain (Raphael, 1999). One study of agreement in maternal self-reported of child maltreatment history around the time of pregnancy suggested that physical neglect may more prone to bias, but evidence of bias for abuse exposures was more limited (Cammack, 2015).

This study has several important limitations. First, the Add Health study population is representative of students enrolled in junior high and high school and is not generalizable to children who have dropped out of school, although Add Health did sample continuation schools. Child abuse is linked with school dropout (Porche, 2011), so these results may not be representative of all abused children, and may be disproportionately representative of resilient abuse survivors, as mentioned above. Also, Add Health utilizes retrospective recall of abuse history, which may be prone to error. However, retrospective self-report also has some advantages to reported or longitudinal abuse studies (e.g., low rates of verified abuse and threats to validity pertaining to children's willingness to disclose). Further, these data were 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 may be associated with preterm birth, namely very preterm birth. These findings should be interpreted with caution. Subsequent studies should focus on more clearly identifying the perpetrator, examining whether abuse occurs in the context of intimate partner violence, and racial/ethnic disparities. The role of related types of common and

potentially modifiable adverse childhood experiences, such as neglect, are also important to ascertain.   A multifaceted approach to measuring child maltreatment is essential to understanding the impact of adverse childhood experiences on preterm birth.

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Table 6.1. Descriptive Characteristics

	Number with Exposure	Population Estimated Percent
	N	% (95% CI)
Age at Delivery	4181	21.68 (21.10, 22.33)
Parental/Adult Caregiver Abuse		
Emotional Abuse	1325	34.31 (32.24 , 36.44)
Physical Abuse	596	15.02 (13.55 , 16.61)
Sexual Abuse	355	8.76 (7.54 , 10.17)
Non-Parental/ Adult Sexual Caregiver Abuse		
Motivated by Non-Physical Threat	555	15.09 (13.62 , 16.68)
Motivated by Physical Force	411	11.04 (9.83 , 12.37)
Preterm Delivery (<37 weeks of gestation)	426	10.29 (9.14 , 11.57)
Very Preterm Delivery (<34 weeks of gestation)	139	3.33 (2.71 , 4.09)
Race		
Hispanic	691	12.05 (8.70 , 16.47)
Black	1017	18.19 (13.78 , 23.62)
Other	291	5.14 (3.77 , 6.96)
White	2179	64.62 (58.15 , 70.60)
Childhood Household Income (in 1994)		
35000 per year	1555	51.23 (46.98 , 55.45)
,=>35000 per year	1518	48.77 (44.55 , 53.02)
Childhood SES (Highest Household Education Level)		
Less than HS	655	15.76 (13.25, 18.64)
HS	2252	60.74 (57.91, 63.49)
4 year degree +	1020	23.51 (20.69, 26.34)
Adult Income		
<40,000 per year	1533	40.53 (37.30 , 43.85)
=>40,000 per year	2420	59.47 (56.15 , 62.70)
Marital Status During Pregnancy		
Not Married, Not Cohabiting	1674	41.40 (37.45 , 45.45)
Cohabiting	1062	25.33 (22.95 , 27.87)
Married	1444	33.27 (30.26 , 36.43)

176

Education at Wave 4 Interview		
High School Degree or Less	1061	27.41 (24.85 , 30.13)
At Least Some Post-Secondary Education	3120	72.59 (69.87 , 75.15)
Smoking During Pregnancy		
Yes	744	21.09 (18.32 , 24.16)
No	3426	78.91 (75.84 , 81.68)

Table 6.2. Distribution of Covariates, Stratified by Preterm Status (<37 weeks)

	Preterm Number in Sample	Population Estimated Percent of Those with Exposure Delivering Preterm
Overall	N	% (95% CI)
Age at Delivery *		
<19 years old at delivery	92	9.79 (7.59 , 12.53)
19-23 years old at delivery	150	9.47 (7.74 , 11.52)
>23 years old at delivery	184	11.36 (9.33 , 13.78)
Race		
Hispanic	62	11.02 (8.52 , 14.15)
Black	117	10.79 (8.57 , 13.50)
Other	23	7.75 (4.02 , 14.43)
White	224	10.22 (8.87 , 11.76)
Childhood Household Income (1994)		
<=35000 per year	166	10.99 (9.13 , 13.18)
>35000 per year	139	9.19 (7.52 , 11.18)
Highest Parental Education Level		
Less than HS	71	10.64 (8.10, 13.84)
HS	235	10.39 (8.69, 12.37)
4 year degree +	98	9.63 (7.53, 12.24)
Income During Wave 4		
<=40000 per year	168	10.33 (8.52 , 12.46)
>40000 per year	233	10.26 (8.59 , 12.21)
Marital Status During Pregnancy *		
Not Married, Not Cohabiting	161	10.33 (8.54 , 12.44)
Cohabiting	129	12.89 (10.41 , 15.86)
Married	136	8.28 (6.56 , 10.40)
Education at Wave 4 Interview *		
Less than High School, HS or GED	123	13.48 (10.99 , 16.43)
At Least Some Post-Secondary Education	303	9.09 (8.00 , 10.31)
Smoking During Pregnancy		
Yes	64	9.45 (7.11 , 12.47)
No	359	10.46 (9.12 , 11.96)

* Chi-Square p <.05

Table 6.3. Associations Between Abuse and Preterm and Very Preterm Birth

	Overall Crude	Adjusted for Race and Childhood SES Measured as Highest Parental Educational Level (Imputed)
	OR (95% CI)	OR (95% CI)
Preterm <37 weeks		
Parental/Adult Caregiver Abuse		
Emotional Abuse	0.93 (0.69 , 1.24)	0.92 (0.69 , 1.24)
Physical Abuse	1.13 (0.79 , 1.63)	1.12 (0.78 , 1.61)
Sexual Abuse	0.92 (0.62 , 1.37)	0.88 (0.58 , 1.33)
Non- Parental/Adult Caregiver Abuse		
Sexual Abuse Motivated by Non-Physical Threat	1.07 (0.76 , 1.51)	1.04 (0.73 , 1.47)
Sexual Abuse Motivated by Physical Force	0.99 (0.68 , 1.44)	0.97 (0.67 , 1.41)
Abuse Sum (continuous)	1.01 (0.95 , 1.07)	1.01 (0.95 , 1.07)
Preterm <34 weeks		
Parental/Adult Caregiver Abuse		
Emotional Abuse	0.65 (0.40 , 1.07)	0.67 (0.40 , 1.11)
Physical Abuse	0.95 (0.55 , 1.63)	0.94 (0.54 , 1.63)
Sexual Abuse	0.81 (0.42 , 1.55)	0.78 (0.40 , 1.51)
Non- Parental/Adult Caregiver Abuse		
Sexual Abuse Motivated by Non-Physical Threat	1.34 (0.76 , 2.34)	1.36 (0.78 , 2.38)
Sexual Abuse Motivated by Physical Force	1.83 (1.04 , 3.20)	1.89 (1.07 , 3.32)
Abuse Sum	1.01 (0.91 , 1.12)	1.00 (0.90 , 1.12)

Table 6.4. Associations Between Abuse and Preterm and Very Preterm Birth, Stratified on

Race/Ethnicity

Crude Models	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Preterm <37 weeks	Hispanic	Black	White	Other Race
Parental/Adult Caregiver Abuse				
Emotional Abuse	1.93 (0.87, 4.24)	1.10 (0.64, 1.90)	0.75 (0.55, 1.02)	1.39 (0.35, 5.54)
Physical Abuse	1.71 (0.61, 4.79)	1.35 (0.68, 2.66)	0.93 (0.61, 1.41)	2.27 (0.67, 7.77)
Sexual Abuse	0.71 (0.21, 2.45)	0.72 (0.29, 1.79)	0.91 (0.54, 1.53)	3.11 (0.93, 10.37)
Non-Parental/Adult Caregiver Abuse				
Sexual Abuse Motivated by Non-Physical Threat	1.18 (0.43, 3.21)	0.69 (0.25, 1.91)	1.06 (0.69, 1.61)	3.99 (1.15, 13.84)
Sexual Abuse Motivated by Physical Force	1.33 (0.41, 4.30)	1.19 (0.57, 2.46)	0.90 (0.54, 1.50)	1.42 (0.36, 5.68)
Abuse Sum (continuous)	0.86 (0.75, 0.99)	0.89 (0.80, 1.00)	1.08 (1.00, 1.17)	1.11 (0.87, 1.42)
Preterm <34 weeks				
Parental/Adult Caregiver Abuse				
Emotional Abuse	2.13 (0.59, 7.84)	0.53 (0.20, 1.39)	0.51 (0.29, 0.90)	0.67 (0.08, 5.29)
Physical Abuse	1.36 (0.38, 5.07)	1.34 (0.43, 4.23)	0.63 (0.29, 1.35)	1.67 (0.21, 13.40)
Sexual Abuse	0.02 (0.00, 0.14)	0.66 (0.16, 2.70)	1.11 (0.48, 2.55)	1.05 (0.11, 10.20)
Non-Parental/Adult Caregiver Abuse				

Sexual Abuse Motivated by Non-Physical Threat	1.56 (0.37, 6.52)	0.55 (0.17, 1.74)	1.47 (0.67, 3.22)	5.38 (0.80, 36.07)
Sexual Abuse Motivated by Physical Force	3.79 (0.98,14.58)	1.36 (0.40, 4.61)	1.96 (0.92, 4.17)	0.86 (0.08, 8.81)
Abuse Sum (continuous)	0.80 (0.64, 0.99)	0.95 (0.78, 1.16)	1.08 (0.94, 1.23)	1.22 (0.86, 1.74)

Table 6.4 (Continued). Associations Between Abuse and Preterm and Very Preterm Birth,

Stratified on Race/Ethnicity

| Models Adjusted for Childhood SES	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Preterm <37 weeks	Hispanic	Black	White	Other Race
Parental/Adult Caregiver Abuse				
Emotional Abuse	1.93 (0.86, 4.33)	1.13 (0.66, 1.93)	0.74 (0.55, 1.01)	1.08 (0.28, 4.12)
Physical Abuse	1.71 (0.63, 4.59)	1.43 (0.71, 2.87)	0.90 (0.60, 1.35)	1.69 (0.36, 7.91)
Sexual Abuse	0.81 (0.24, 2.69)	0.77 (0.31, 1.92)	0.89 (0.52,1.51)	1.76 (0.34, 9.13)
Non-Parental/Adult Caregiver Abuse				
Sexual Abuse Motivated by Non-Physical Threat	1.05 (0.38, 2.93)	0.69 (0.24, 1.96)	1.04 (0.67, 1.59)	2.95 (0.57, 15.34)
Sexual Abuse Motivated by Physical Force	1.33 (0.41, 4.31)	1.21 (0.58, 2.53)	0.87 (0.53, 1.43)	0.61 (0.08, 4.89)
Abuse Sum (continuous)	0.87 (0.75, 1.00)	0.90 (0.81, 1.00)	1.09 (1.01, 1.17)	1.09 (0.83, 1.44)
Preterm <34 weeks				
Parental/Adult Caregiver Abuse				
Emotional Abuse	2.20 (0.59, 8.20)	0.53 (0.20, 1.38)	0.50 (0.28, 0.89)	0.70 (0.11, 4.61)
Physical Abuse	1.42 (0.39, 5.15)	1.42 (0.45, 4.50)	0.59 (0.27, 1.28)	1.83 (0.25, 13.16)
Sexual Abuse	0.02 (0.00, 0.13)	0.70 (0.17, 2.89)	1.01 (0.44, 2.30)	0.96 (0.10, 9.55)

Non-Parental/Adult Caregiver Abuse				
Sexual Abuse Motivated by Non-Physical Threat	1.47 (0.35, 6.21)	0.54 (0.17, 1.72)	1.33 (0.61, 2.88)	7.54 (1.24, 45.75)
Sexual Abuse Motivated by Physical Force	4.08 (1.05,15.96)	1.36 (0.41, 4.57)	1.77 (0.86, 3.65)	1.04 (0.09, 11.72)
Abuse Sum (continuous)	0.80 (0.64, 0.99)	0.96 (0.78, 1.16)	1.10 (0.96, 1.26)	1.21 (0.89, 1.64)

Table 6.5. Associations Between Abuse and Preterm and Very Preterm Birth, Stratified by Age of Abuse Onset

Crude Association	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Preterm <37 weeks	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Parental/Adult Caregiver Abuse				
Emotional Abuse	0.63 (0.38 , 1.06)	0.81 (0.36 , 1.81)	1.07 (0.67 , 1.71)	1.25 (0.80 , 1.93)
Physical Abuse	1.21 (0.59 , 2.46)	0.76 (0.31 , 1.89)	1.39 (0.79 , 2.43)	1.06 (0.49 , 2.30)
Sexual Abuse	0.84 (0.25 , 2.87)	1.23 (0.66 , 2.29)	1.07 (0.50 , 2.27)	0.54 (0.21 , 1.37)
Non-Parental/Adult Caregiver Abuse				
Sexual Abuse Motivated by Non-Physical Threat	0.58 (0.22 , 1.56)	1.51 (0.76 , 3.00)	1.02 (0.50 , 2.07)	1.23 (0.68 , 2.23)
Sexual Abuse Motivated by Physical Force	0.65 (0.30 , 1.39)	1.13 (0.54 , 2.34)	1.14 (0.49 , 2.65)	1.03 (0.53 , 1.97)
Preterm <34 weeks				
Parental/Adult Caregiver Abuse				
Emotional Abuse	0.68 (0.31 , 1.47)	0.13 (0.02 , 0.97)	0.64 (0.30 , 1.33)	1.00 (0.42 , 2.37)
Physical Abuse	0.43 (0.14 , 1.37)	0.53 (0.13 , 2.11)	1.98 (0.86 , 4.56)	0.78 (0.26 , 2.32)
Sexual Abuse	0.61 (0.08 , 4.70)	1.38 (0.53 , 3.60)	0.80 (0.19 , 3.33)	0.44 (0.09 , 2.22)
Non-Parental/Adult Caregiver Abuse				

Sexual Abuse Motivated by Non-Physical Threat	0.62 (0.20 , 1.94)	1.97 (0.69 , 5.61)	1.36 (0.49 , 3.76)	1.48 (0.61 , 3.60)
Sexual Abuse Motivated by Physical Force	0.75 (0.21 , 2.76)	2.30 (0.88 , 5.97)	2.12 (0.72 , 6.26)	2.02 (0.80 , 5.07)

Figure 6.1. Directed Acyclic Graph of Relationships Between Child Abuse, Preterm Birth, Intermediates, and Potential Confounders
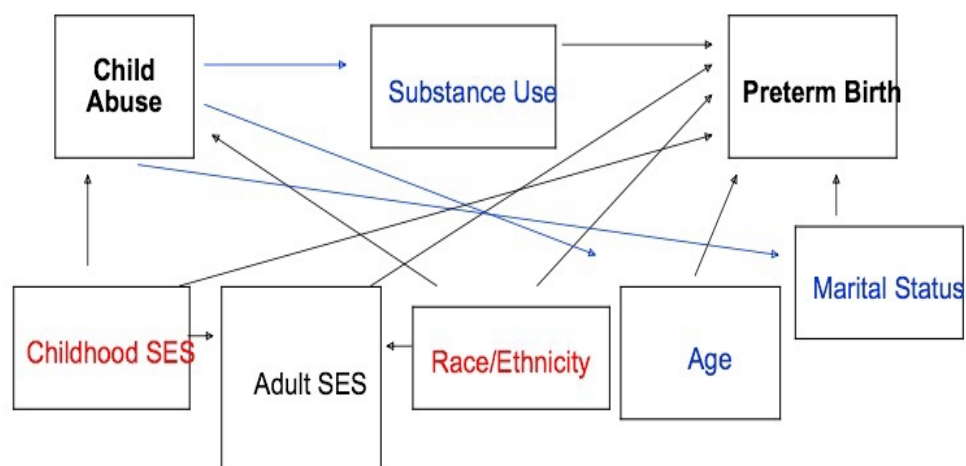
CHAPTER 7

Maternal History of Child Abuse and Continued Smoking Through Pregnancy

Abstract

Background: Smoking during pregnancy is a prevalent behavior that places women at risk for adverse pregnancy outcomes. Psychosocial factors, such as childhood maltreatment, may be important predictors of smoking behaviors during pregnancy. However, few studies have looked at this association in pregnant women, and outcomes related to continuation of smoking are frequently not considered.

Methods: Women who identified as being pregnant during Wave 3 (ages 18-26) or Wave 4 (ages 24-32) of the National Longitudinal Study of Adolescent to Adult Health were included in the present study (N=671). They completed questionnaires about historical regular smoking (at least once a day for 30 consecutive days), current smoking (any smoking in the last 30 days), and history of emotional, physical, and sexual abuse perpetrated by parents/adult caregivers and other individuals.

Results: 272 (weighted percentage: 45.73% (95% CI: 39.90, 51.67) of the women who were pregnant during the Wave 3 or 4 interview had a history of regular smoking. Among these women, 108 (weighted percentage: 45.25% (95% CI: 37.88, 52.84) reported smoking at least once in the last 30 days. Sexual abuse perpetrated by non-parents/caregivers that was motivated by physical force was associated with continued smoking during pregnancy (aRR= 1.64, 95% CI: (1.12, 2.42)). When stratified by depressive symptoms (no or minimal symptoms versus low to high symptoms),

associations between abuse and continued smoking were limited to women with depressive symptomatology.

Conclusions: Pregnant women reporting childhood trauma appear to be diverse with respect to the impact of that history on smoking. Among women with low to high depressive symptoms, maternal history of childhood maltreatment is a risk factor for continued smoking in pregnancy. Future studies should further explore this topic by looking at smoking cessation in studies that measured it more proximally to pregnancy. If these findings are causal, they highlight the importance of assessing both childhood trauma history and current depressive symptomatology in this at-risk group of pregnant women.

Introduction

Smoking during pregnancy has been associated with several adverse perinatal outcomes, including fetal growth restriction (Blatt, 2015), stillbirth (Varner, 2014), and preterm birth (Dahlin, 2016), as well as subsequent child outcomes, including emotional self-regulation (Wiebe, 2015) and academic performance (Anthopolos, 2013). It is a prevalent and serious public health problem. Although smoking rates have decreased steadily since the 1990s, a significant proportion of women report smoking during their pregnancies. Pregnancy Risk Assessment Monitoring System (PRAMS) data from 2011 reports that 10% of women reported smoking during the last 3 months of pregnancy, and of women who smoked 3 months before pregnancy, 45% continue to smoke in pregnancy (CDC, 2016).

Several studies have associated smoking with a history of childhood maltreatment (Alcala, 2016; Campbell, 2016; Remigio-Baker, 2017; Yeoman, 2013). These studies are largely cross-sectional in nature, although some studies have examined longitudinal smoking trends, including smoking cessation (Smith, 2015; Taha, 2014), and also found associations. However, studies of non-pregnant women may not be generalizable to pregnant women for two key reasons. First, smoking decreases fertility (Alvarez, 2015), so women exposed to childhood trauma who smoke may not become pregnant. Second, women often actively attempt to refrain from harmful behaviors including smoking during pregnancy (Jones, 2016).

Among pregnant women, only a few studies have examined the association between history of childhood trauma and smoking, but these limited findings support a relationship. Grimstad (1999) reported a relationship between smoking and history of childhood sexual abuse, and two studies (Chung, 2010; Harville, 2010) reported a dose-response association between adverse childhood experiences, which included abuse, and smoking. Importantly, however, none of these studies have directly looked at smoking cessation or continued smoking into pregnancy as the outcome. Smoking initiation generally starts prior to pregnancy, therefore utilizing cross-sectional assessment of smoking status during pregnancy may not be the most relevant outcome for interventions. One study found that childhood maltreatment predicted responses to a psychosocial smoking cessation intervention in pregnant women (Blalock, 2013); however, these results cannot be generalized to cessation outside of the context of these specific interventions.

Common reasons for smoking and failure to stop smoking often pertain to stress (Maxson, 2012). Depression and depressive symptomatology are also important determinants of smoking and smoking cessation (Goodwin, 2007). Moreover, some studies suggest smoking cessation interventions that address depressive symptomatology may be more appropriate for individuals with psychosocial problems rather than interventions that focus solely on physical health benefits (Cinciripini, 2010; Miyazaki, 2015), highlighting the need to address root causes of smoking. Childhood maltreatment is a common antecedent of mental health problems, including depression (Mandelli, 2015). Thus, it is plausible that addressing child maltreatment, through primary prevention or secondary prevention of depression, would have an impact on smoking.

This also suggests that depression may be an important determinant of smoking behaviors among pregnant women with histories of childhood maltreatment, although there is little data that has directly examined this.

The goal of the present study was twofold. We sought to determine 1) whether maternal exposure to child abuse is associated with smoking during pregnancy, among women who have ever been regular smokers and 2) whether depressive symptoms modify this relationship.

Materials and Methods

Study Population

The National Longitudinal Study of Adolescent to Adult Health ("Add Health") (Harris, 2009) interviewed over 90,000 adolescents in grades 7 through 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 age 18 to 26 in 2001-2002 (Wave III; n=15,179; response rate=77.4%) and ages 24 to 32 in 2008-2009; (Wave IV n=15,701; response rate= 80.3%). Inclusion criteria for the present study were as follows: 1) participation in study waves III and IV; 2) self-report of being pregnant at the time of the wave III or IV interview; and 3) data on any of the childhood abuse questions (N=671). Permission to conduct secondary analyses was approved by the Emory University Institutional Review Board.

Exposure Assessment

Abuse history was assessed via five questions during the Wave IV interview. Three questions assessed 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, 2009; Briere, 2003; Crowley, 2003; Straus, 1998). The questions were specifically phrased as follows: Parental/adult caregiver emotional abuse, physical, and sexual abuse was asked as: "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?", respectively. 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 an affirmative response to a question, participants were subsequently asked about the age abuse first occurred. Child abuse was defined as beginning when the person was <18 years old.

Abuse subtypes were considered as dichotomous variables, selecting cut points that yield prevalences approximating those found in the Adverse Childhood Experiences questionnaire administered to a multi-state, population based sample. (MMWR, 2010). For these data, the cutpoints were 1 or more total times for sexual abuse (both parental/adult caregiver and non-parental/adult caregiver subtypes), 2 or more times for physical abuse, and 3 or more times for emotional abuse.

Outcome Assessment

Lifetime history of regular smoking was assessed by the question, "Have you ever smoked cigarettes regularly--that is, at least one cigarette every day for 30 days?" Smoking in the last 30 days was asked as, "During the past 30 days, on how many days did you smoke cigarettes?". The outcome variable, continued smoking, was defined as any recent smoking among those who had smoked at all in the last thirty days, as compared to women who had ever regularly smoked (but not in the last 30 days).

Covariates/Confounders

Maternal race/ethnicity and participant report of highest household parental education were considered as confounders. We also characterized the women according to education (as measured in the Wave 4 interview), marital status, parity, income, and age. We did not consider these variables as confounders because they may represent intermediates in the causal pathway between abuse and smoking behavior.

Depressive Symptoms

Depressive symptoms were measured with a modified version of the 4-item Centers for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977). This 4-item scale is a modification of a previously used 5-item scale (Perreria, 2005), with the question, "You had trouble keeping your mind on what you were doing, during the past seven days" deleted since memory issues may overlap with pregnancy symptoms. The scale showed good internal consistency (Cronbach's alpha: Wave3 =.80, Wave 4=.75). Scores were dichotomized at 0-1 versus 2-12; we chose this cutpoint instead of a cutpoint that corresponded to clinical depression diagnoses because subclinical depressive symptomatology may contribute to smoking behaviors (Tan, 2011).

Analyses

Variables were first examined for normality (where appropriate) and plausibility. We examined the distributions of the exposure, outcome, and covariates, and also looked at the bivariate relationships between covariates and continued smoking via chi-squared tests. To examine relationships between abuse and continued smoking, we calculated risk ratios and risk differences with predicted margins (Bieler, 2010), using SAS callable SUDAAN. In addition to crude models, we ran models adjusted for race and participant reported childhood socioeconomic status (highest level of education in a household). Even though the response rate on this item was high (94%), non-response was associated with exposure to abuse. Thus, for our primary analysis, we used PROC HOTDECK to impute missing responses for our SES variable with 30 imputations. All analyses were

conducted with complex sample weighting to account for the Add Health sampling design to produce estimates for the source population using SAS callable SUDAAN (Chen and Chantala, 2014).

Results

There were 671 women who reported being pregnant when interviewed in Waves 3 (N=266) and 4 (N=421). 16 of these women were pregnant in both waves 3 and 4 and for these analyses we used their data from Wave 3. Table 1 shows the distribution of the exposure, outcome, and participant characteristics of the 671 women who reported pregnancies. Close to half of these women reported regular smoking at some point during their lives (N=272), and among those with regular smoking histories, participants had smoked regularly for an average of 8.46 years at the time of the interview. A substantial minority of women reported exposure to the five categories of abuse.

Table 2 shows bivariate analyses of the relationship between participant characteristics and continued smoking among in pregnancy women with histories of regular smoking. Continued smoking was more common among women who were Black, whose highest parent household education was below a 4-year college degree, did not have at least some college education by the Wave 4 interview, made less than 35,000 dollars per year during the Wave 4 interview, and were nulliparous.

Table 3 shows the relationship between the five types of abuse and continued smoking, quantified as risk differences and risk ratios for the overall study sample. Only non-parental sexual abuse motivated by physical force was associated with continued

smoking. In models adjusted for childhood SES and race, the effect was somewhat attenuated, but results remained statistically significant. Similar patterns were observed for both risk differences and risk ratios.

Tables 4 and 5 show the relationships between the five types of abuse and continued smoking, quantified as risk ratios and risk differences, respectively, stratified by depressive symptomology. Among individuals with moderate to severe depressive symptoms, three of the five types of abuse, specifically parent/adult caregiver perpetrated physical abuse and non-parental/caregiver sexual abuse motivated by verbal threat and physical force, were associated with continued smoking. Similar patterns were observed for risk differences.   By contrast, among individuals who had no or minimal depressive symptomatology, none of the five abuse types were associated with continued smoking when quantified as risk ratios, and several associations trended towards inverse associations.   In this same group (with no or minimal depressive symptoms), physical abuse was significantly inversely associated with continued smoking when quantified as a risk difference. Results of all adjusted models were similar when not imputing missing data for child SES. In models that incorporated an interaction term for depressive symptoms and abuse exposure, statistically significant interaction terms were present for parental/caregiver sexual and physical abuse.

We also conducted sensitivity analyses utilizing smoking in the last thirty days that was not conditioned on ever smoking as the outcome (i.e., a cross-sectional assessment of smoking). Compared to analyses of continued smoking, point estimates were generally similar in magnitude, albeit with increased statistical power due to a larger

sample size.   An exception was emotional abuse, which was significantly associated with cross sectional smoking (aRR= 1.46 (95% CI:1.02, 2.08)).

Discussion

These findings suggest that child abuse is associated with continued smoking during pregnancy.   Significant associations were limited to women who have some depressive symptomology. Although most findings suggesting a possible inverse relationship were not statistically significant, the inverse relationship between abuse and continued smoking indicates a possible protective effect of child abuse among those with no/minimal depressive symptomatology.   There was evidence of both additive and multiplicative interaction, as we observed the above associations as both risk differences and risk ratios.   The risk differences were of high magnitude, suggesting that alleviation of child abuse, particularly sexual abuse perpetrated by non-parents/adult caregivers, would have a large public health impact on smoking cessation in pregnant women.

Some of our findings, such as evidence for interaction between depressive symptoms and abuse history and smoking, align with the literature. A limited number of investigations have found interactions between smoking and depression in predicting other health outcomes.   These studies examine outcomes such as parenting behaviors (Kluczniok, 2016; Zalewski, 2013) and some preliminary findings suggest this may also extend to perinatal outcomes (Buss, 2016; Culhane, 2016; Walsh, 2016).

Our findings somewhat diverge from other studies that have found overall main effects between adverse childhood experiences and smoking behaviors (Chung, 2010;

Grimstad, 1999; Harville, 2010). This may be, in part, because we looked at continued

smoking as the outcome, rather than a cross sectional assessment of current smoking that

included women with no history of smoking. However, there may be another reason as

well. Our sample may represent a resilient subset of adults with childhood abuse

experience. Resilience has many different definitions and conceptualizations

(Southwick, 2014), one of which is defined as a stable trajectory of healthy functioning

after a highly adverse event. It could explain these divergent findings since sampling of

the Add Health study population was dependent on enrollment in school. Child abuse is

a known risk factor for dropping out of school (Porsche, 2011); thus, in a population

where study enrollment was not dependent on school enrollment, adults reporting having

been abused as children would include both resilient and less resilient individuals who

had dropped out of school.

Even within this resilient sample, it may be possible to further categorize women

as having diverse responses being exposed to child abuse.   Our findings of null or

protective effects of smoking in those with little or no depressive symptomatology could

also be due resilience and/or post traumatic growth.   We contend that being euthymic

several years after childhood abuse occurred may indicate the presence of a resilient

trajectory, as defined previously. Ideally such a trajectory would be confirmed by

additional depressive symptom assessments during pregnancy, rather than a single one,

but these data were not available.   Posttraumatic growth, defined as positive

psychological change experienced as a result of the struggle with highly challenging life

circumstances (Tedeschi, 2004) is also a common response to trauma (Elderton, 2015).

Although posttraumatic growth was not directly measured in this study, the fact that there

were some protective effects of abuse suggests that such changes may have occurred. In an article that examined determinants of posttraumatic growth in survivors of sexual abuse, abuse perpetrated by a family member was more strongly associated with posttraumatic growth than abuse perpetrated by a stranger (Lev-Weisel, 2005). This is in line with our findings, where the associations between sexual abuse perpetrated by adult/parent caregivers were meaningfully different in those with moderate to severe depressive symptoms than associations in women with minimal or no depressive symptoms. That is, a pattern that was most consistent with posttraumatic growth was only found in women experiencing this type of sexual abuse.

This study has important limitations. First, smoking was collected via-self report and may be prone to misclassification, given that smoking during pregnancy is well-known to be harmful in pregnancy and some women may be hesitant to disclose engaging in behaviors that may cause fetal harm. Second, this study did not examine smoking behaviors at a standardized gestational age and measurement of gestational age at interview was recorded imprecisely. However, timing of enrollment in pregnancy was random and therefore unlikely to introduce systematic bias. Finally, the study design precluded analyses of smoking in the immediate preconception period (e.g., less than 3 months before pregnancy), which may represent an outcome that is more relevant to designing cessation interventions. However, given that smoking cessation may have persistent effects that continue for months or even years after exposure (e.g., changes in weight, mental health status, inflammatory markers (Bush, 2016)) which could affect pregnancy, an understanding of smoking cessation that occurs not immediately before pregnancy remains important. Thus, studies that examine preconception smoking

cessation, both close to the timing of conception as well as earlier periods, and related interventions would be important additions to the literature.

A second related limitation is that the direction of the relationship between depressive symptoms and smoking is unclear from these data. If women quit smoking several years prior to being pregnant, then depressive symptoms may be a response to smoking cessation. There is some research suggesting that women with histories of depression may have protracted (i.e., greater in duration than 3 months) depressive responses to smoking cessation (Covey, 1997). Thus, with the present study design, our ability to make causal inferences is compromised. Future studies utilizing longitudinal study designs are important to determine the presence and strength of this possible source of bias.

In conclusion, if these findings are causal, they suggest that additional support is needed for abused women with depressive symptomatology in order to abstain from smoking during their pregnancies. Future studies should focus on examining childhood maltreatment more comprehensively (e.g., include neglect). They should also consider the role of child abuse history in relation to cessation of other harmful behaviors in pregnant women (e.g., illicit drug use). Finally, future studies should further explore child abuse as an exposure that has heterogeneous effects on victims. These studies should consider additional measures of resilience/and or post-traumatic growth as potential effect modifiers and elucidate factors that encourage resilience and/or posttraumatic growth.

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Table 7.1. Descriptive Characteristics of Women Who Were Pregnant in Waves 3 and 4

	N with Characteristic	Weighted % (95% CI)
Parent/Adult Caregiver Abuse		
Emotional Abuse	200	32.51 (27.53 , 37.91)
Physical Abuse	91	12.79 (9.44 , 17.10)
Sexual Abuse	55	7.89 (5.73 , 10.78)
Non-Parental/Adult Caregiver Abuse		
Sexual Abuse Motivated by Verbal Threat	76	11.92 (8.76 , 16.03)
Sexual Abuse Motivated by Physical Threat	59	8.86 (6.08 , 12.73)
Any Smoking In Last 30 Days	108	20.74 (16.38 , 25.90)
Ever Smoked Regularly (at least once every day for 30 days)	272	45.73 (39.90 , 51.67)
Continued Smoking (Any Smoking in Last Thirty Days Among Those Who Once Regularly Smoked)	108	45.25 (37.88 , 52.84)
Low to Severe Depressive Symptoms	323	46.76 (41.36 , 52.24)
Nulliparous	303	44.88 (39.42 , 50.47)
Age		Mean= 25.48 (25.06 , 25.91)
Childhood SES (Highest Parental Education)		
No HS or GED	88	12.61 (9.49 , 16.57)
Completed HS or GED	347	59.01 (52.43 , 65.10)
Four Year College Degree or Above	201	28.38 (22.21 , 35.48)
Race		
Hispanic	88	9.62 (6.56 , 13.82)
African American	145	15.81 (11.09 , 22.06)
Other	51	6.20 (3.73 , 10.13)
White	386	68.37 (61.08 , 74.89)

Table 7.2. Distribution of Continued Smoking Among Those Who Had Ever Been Regular

Smokers (N=272) According to Participant Characteristics.

	Number Who Continued to Smoke	Population Estimated Percent of Those with Exposure with Continued Smoking (95% CI)
Race *		
Hispanic	6	41.07 (17.13 , 70.15)
Black	12	61.09 (31.19 , 84.47)
Other	10	43.00 (17.63 , 72.67)
White	80	44.42 (35.80 , 53.39)
Highest Household Parental Education Level *		
No HS or GED	14	54.44 (31.89 , 75.30)
Completed HS or GED	76	51.98 (42.84 , 61.00)
Four Year College Degree or Above	16	22.99 (12.33 , 38.79)
Depressive Symptoms		
No or Minimal Depressive Symptoms	49	43.97 (33.69 , 54.79)
Low to High Depressive Symptoms	59	46.54 (35.24 , 58.22)
Parity *		
Nulliparous	76	53.76 (44.25 , 63.00)
Parous	32	31.99 (21.79 , 44.25)
Education at Wave 4 Interview *		
Less than High School, HS or GED	51	66.90 (54.59 , 77.26)
At Least Some Post-Secondary Education	57	34.55 (26.90 , 43.09)
Income During Wave 4*		
<=40000 per year	55	65.60 (53.12 , 76.24)
>40000 per year	47	32.35 (23.58 , 42.55)

* Chi-Square p <.05

Table 7.3. Overall Associations Between Abuse and Continued Smoking Among Pregnant

Women Who Had Ever Smoked (Quantified as Risk Differences and Risk Ratios)

	Crude Risk Difference	Adjusted Risk Difference	Crude Risk Ratio	Adjusted Risk Ratio
	(95% CI)	(95% CI)	(95% CI)	(95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	0.01 (-0.13 , 0.15)	0.01 (-0.13 , 0.15)	1.03 (0.76 , 1.40)	1.03 (0.77 , 1.37)
Physical Abuse	0.12 (-0.06 , 0.30)	0.09 (-0.09 , 0.27)	1.29 (0.91 , 1.81)	1.21 (0.86 , 1.71)
Sexual Abuse	0.00 (-0.27 , 0.27)	-0.02 (-0.31 , 0.27)	1.00 (0.53 , 1.88)	0.95 (0.47 , 1.90)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	0.16 (-0.08 , 0.40)	0.18 (-0.04 , 0.40)	1.38 (0.91 , 2.11)	1.42 (0.97 , 2.08)
Motivated by Physical Force	0.30 (0.06 , 0.54)	0.27 (0.03 , 0.51)	1.72 (1.18 , 2.52)	1.64 (1.12 , 2.42)

Adjusted for race and child SES

Table 7.4. Associations (Risk Ratios) Between Abuse and Continued Smoking Among Pregnant Women Who Had Ever Smoked: 0 or 1 Depressive Symptoms vs 2+ Depressive Symptoms

	0-1 Symptoms Crude RR (95% CI)	0-1 Symptoms Adjusted RR (95% CI)	2+ Symptoms Crude RR (95% CI)	2+ Symptoms Adjusted RR (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	0.98 (0.59 , 1.63)	0.89 (0.55 , 1.43)	1.07 (0.68 , 1.67)	1.03 (0.69 , 1.53)
Physical Abuse	0.48 (0.16 , 1.49)	0.54 (0.17 , 1.77)	1.78 (1.22 , 2.61)	1.64 (1.11 , 2.42)
Sexual Abuse	0.23 (0.03 , 1.56)	0.20 (0.02 , 1.86)	1.65 (1.02 , 2.68)	1.47 (0.85 , 2.57)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	0.86 (0.36 , 2.04)	1.03 (0.50 , 2.12)	1.77 (1.11 , 2.84)	1.71 (1.08 , 2.71)
Motivated by Physical Force	1.56 (0.98 , 2.48)	1.57 (0.96 , 2.57)	1.86 (1.15 , 3.01)	1.73 (1.07 , 2.81)

Table 7.5. Associations (Risk Differences) Between Abuse and Continued Smoking Among

Pregnant Women Who Had Ever Smoked: 0 or 1 Depressive Symptoms vs 2+ Depressive

Symptoms

	0-1 Symptoms Crude RD (95% CI)	0-1 Symptoms Adjusted RD (95% CI)	2+ Symptoms Crude RD (95% CI)	2+ Symptoms Adjusted RD (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	-0.01 (-0.23, 0.21)	-0.05 (-0.25, 0.15)	0.03 (-0.17, 0.23)	0.01 (-0.17, 0.19)
Physical Abuse	-0.24 (-0.51, 0.03)	-0.21 (-0.52, 0.10)	0.31 (0.11, 0.51)	0.26 (0.06, 0.46)
Sexual Abuse	-0.36 (-0.60, 0.12)	-0.38 (-0.62, -0.14)	0.29 (-0.02, 0.60)	0.21 (-0.14, 0.56)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	-0.06 (-0.39, 0.27)	0.01 (-0.30, 0.32)	0.31 (0.06, 0.56)	0.28 (0.03, 0.53)
Motivated by Physical Force	0.23 (-0.04, 0.50)	0.24 (-0.05, 0.53)	0.36 (0.07, 0.65)	0.31 (0.02, 0.60)

CHAPTER 8

Supplementary Analyses

This chapter summarizes results for additional analyses relevant to chapters 6 and 7.

Chapter 6 Analyses

Alternate Childhood SES Measure and Selection Bias

Adjusted models chapters 6 and 7 controlled for race and childhood SES. Childhood SES can be conceptualized in various different ways, and although an education based measure may be a more relevant SES measure for abuse, exploration of income based measures may also be appropriate. Since measurement of parental income from a participant was not asked, we utilized a measure from an interview completed by a parent. These two measures were moderately correlated (r= 0.35). One would not expect these measures to be perfectly correlated with each other, given that income and education captures different aspects of socioeconomic status.

Parent household income had the disadvantage of a relatively low response rate (3076/4181), as many parents were not able to be interviewed. However, non-response was not associated with any of the abuse measures, and non-response was not meaningfully associated with these demographic characteristics, including race, adulthood income, and adulthood education. By contrast, child SES as measured from participant report had a higher response rate (3927/4181), but non-response was

meaningfully and significantly associated with all forms of child abuse (% of those experiencing abuse for those who had information on SES versus those who did not for not: 33.58% versus 44.48%, 14.48% versus 22.42%, 8.77 versus 16.44% for parent/ caregiver emotional, physical, and sexual abuse, respectively; and 15.07 versus 22.30%, 11.02% versus 19.14% for non-parent /caregiver sexual abuse motivated by non-physical threat and verbal force, respectively (all p<.05)).

Another strategy we used to compare the two SES measure was to examine the effect of adjustment for SES in women who have complete data on both SES variables. The tables below show crude abuse-PTB/vPTB associations and those adjusted for SES. In analyses limited to women who only have complete data on both SES variables (see table 1 below), the effect sizes are similar in both crude and models adjusted for both SES measures. By contrast, table 2, which shows the crude associations for all women regardless of missing data, reveals a large difference between the crude and adjusted models when considering vPTB as the outcome. This suggests that changes in the sample introduce selection bias and gives further weight to using multiple imputation to eliminate this source of bias. However, it is important to note that this analysis cannot be used to definitively ascertain selection bias, as it assumes that the effect of confounding by SES is the same for those who have SES data available and for those who do not.

Table 8.1. Associations Between Abuse and Preterm and Very Preterm Birth, Only Using

Women with Data on Both SES Variables

	Overall Crude	Adjusted for Childhood SES (Parent Household Income)	Adjusted for Childhood SES (Childhood Household Education)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Preterm <37 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.78 (0.54, 1.14)	0.78 (0.54, 1.14)	0.78 (0.54, 1.14)
Physical Abuse	1.05 (0.63, 1.74)	1.03 (0.63, 1.69)	1.06 (0.64, 1.75)
Sexual Abuse	0.60 (0.31, 1.15)	0.58 (0.30, 1.12)	0.60 (0.31, 1.16)
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.06 (0.69, 1.64)	1.06 (0.69, 1.62)	1.07 (0.69, 1.65)
Motivated by Physical Force	0.87 (0.55, 1.37)	0.85 (0.54, 1.35)	0.87 (0.55, 1.38)
Abuse Sum (continuous)	1.06 (.98, 1.14)	1.06 (0.98, 1.14)	1.05 (0.98, 1.14)
Preterm <34 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.50 (0.27, 0.93)	0.49 (0.27, 0.91)	0.50 (0.27, 0.93)
Physical Abuse	0.55 (0.22, 1.42)	0.54 (0.21, 1.39)	0.55 (0.22, 1.41)
Sexual Abuse	0.43 (0.16, 1.14)	0.42 (0.16, 1.11)	0.43 (0.16, 1.12)
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.30 (0.68, 2.47)	1.29 (0.68, 2.45)	1.27 (0.67, 2.41)
Motivated by Physical Force	1.69 (0.85, 3.36)	1.66 (0.84, 3.28)	1.66 (0.84, 3.29)
Abuse Sum (continuous)	1.08 (0.96, 1.21)	1.08 (0.97, 1.21)	1.08 (0.96, 1.21)

Table 8.2. Associations Between Abuse and Preterm and Very Preterm Birth, Using All Women

	Overall Crude	Adjusted for Childhood SES (Parent Household Income)	Adjusted for Childhood SES (Childhood Household Education)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Preterm <37 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.78 (0.54, 1.14)	0.78 (0.54, 1.14)	0.78 (0.54, 1.14)
Physical Abuse	1.05 (0.63, 1.74)	1.03 (0.63, 1.69)	1.06 (0.64, 1.75)
Sexual Abuse	0.60 (0.31, 1.15)	0.58 (0.30, 1.12)	0.60 (0.31, 1.16)
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.06 (0.69, 1.64)	1.06 (0.69, 1.62)	1.07 (0.69, 1.65)
Motivated by Physical Force	0.87 (0.55, 1.37)	0.85 (0.54, 1.35)	0.87 (0.55, 1.38)
Abuse Sum (continuous)	1.06 (.98, 1.14)	1.06 (0.98, 1.14)	1.05 (0.98, 1.14)
Preterm <34 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.65 (0.40, 1.07)	0.49 (0.27, 0.91)	0.50 (0.27, 0.93)
Physical Abuse	0.95 (0.55, 1.63)	0.54 (0.21, 1.39)	0.55 (0.22, 1.41)
Sexual Abuse	0.81 (0.42, 1.55)	0.42 (0.16, 1.11)	0.43 (0.16, 1.12)
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.34 (0.76, 2.34)	1.29 (0.68, 2.45)	1.27 (0.67, 2.41)
Motivated by Physical Force	1.83 (1.04, 3.20)	1.66 (0.84, 3.28)	1.66 (0.84, 3.29)
Abuse Sum (continuous)	1.01 (0.91, 1.12)	1.08 (0.97, 1.21)	1.08 (0.96, 1.21)

Misclassification of Childhood Abuse and Bias Analyses

In chapters four and five, physical neglect was shown to have suboptimal

reliability, and there was some evidence that it may be subject to recall bias with respect

to perinatal outcomes. All abuse types showed at least moderate reliability; however, given that these analyses were unable to directly examine validity, it is important to further consider that reporting of abuse may be subject to misclassification. Thus, to consider the impact of misclassification of abuse on PTB/vPTB in chapter 6 analyses, simple bias analyses with the crude, unweighted data were performed (Lash, 2009) This was carried out by computing corrected associations with assumptions of different sensitivities and specificities for abuse exposure.

In general, one would assume that child maltreatment has higher specificity than sensitivity, given that the literature has shown that false positives are less common than false negatives. Since there is little agreement about the magnitude of these differences, particularly sensitivity, we tested a range of different parameters. For one set of analyses, the sensitivities and specificities were assumed to be the same for those who experienced PTB/vPTB versus those who had term deliveries. Next, we assumed that those who experienced PTB/vPTB may have higher sensitivities than those who did not experience this outcome (i.e., we assumed that recall bias is present).

Table 3 shows the crude, unweighted observed associations between abuse and PTB/vPTB and those same associations when we corrected (i.e., true associations) the data under selected assumed sensitivities. We assumed the specificity for each of the abuse types was .95 and tested assumed sensitivities of .4, .6, and .8. Sensitivities were assumed to be the same in those with PTB/vPTB and those without vPTB. Observed associations, relative to the true corrected associations, were biased towards the null as one would expect to see with non-differential misclassification. The difference between the observed associations and the true associations increased with decreasing sensitivity.

Table 4 shows the crude observed results for the abuse-PTB/vPTB associations when we assumed that the sensitivities and specificities differed for PTB/ vPTB and term deliveries.   All specificities were assumed to be .95. First, we compared small differences in sensitivities in those with term births versus preterm/very preterm births (.4 vs .5, 6.vs .7, and .8 vs. 9), then we considered greater differences in the sensitivities (.4 vs .7 and .6 vs. .9). Results showed that for small differences in sensitivities in those with preterm births versus term births, the observed associations tended to be biased towards the null (relative to the true associations). However, when we considered greater differences in the sensitivities, observed associations tended to be biased in a positive direction, consistent with what one would expect with recall bias.

Table 8.3. Associations Between Abuse and Preterm and Very Preterm Birth, With Varying

Sensitivities and Specificities for Abuse Exposure (Same for those With and Without PTB/vPTB)

		Sensitivity=.4 Specificity=.95	Sensitivity=.6 Specificity=.95	Sensitivity=.8 Specificity=.95
Preterm <37 weeks	Observed OR (95% CI)	Corrected OR (Truth)	Corrected OR (Truth)	Corrected OR (Truth)
Sensitivity				
Parent/Caregiver Abuse				
Emotional Abuse	0.94 (0.76 - 1.17)	0.82	0.91	0.93
Physical Abuse	1.02 (0.77 - 1.35)	1.03	1.03	1.03
Sexual Abuse	0.99 (0.69 - 1.42)	0.98	0.98	0.98
Non-Parent/Caregiver Sexual Abuse				
Motivated by Non Physical Threat	1.02 (0.76 - 1.37)	1.03	1.03	1.03
Motivated by Physical Force	1.04 (0.74 - 1.45)	1.08	1.08	1.07
Preterm <34 weeks				
Parent/Caregiver Abuse				
Emotional Abuse	0.83 (0.57 - 1.21)	0.58	0.75	0.79
Physical Abuse	0.95 (0.58 - 1.55)	0.91	0.92	0.92
Sexual Abuse	0.93 (0.49 - 1.73)	0.82	0.83	0.83
Non-Parent/Caregiver Sexual Abuse				
Motivated by Non Physical Threat	1.17 (0.73 - 1.88)	1.33	1.29	1.27
Motivated by Physical Force	1.56 (0.96 - 2.53)	2.33	2.17	2.11

Table 8.4. Corrected Associations Between Abuse and Preterm and Very Preterm Birth, With Varying Sensitivities and Specificities for Abuse Exposure (Not Assumed to be the Same for PTB/vPTB and Term Deliveries)

	Observed Data	PTB/vPTB Sensitivity=.5, Specificity=.95 TERM Sensitivity=.4, Specificity=.95	PTB/vPTB Sensitivity=.7, Specificity=.95 TERM Sensitivity=.6, Specificity=.95	PTB/vPTB Sensitivity=.9, Specificity=.95 TERM Sensitivity=.8, Specificity=.95
	OR (95% CI)	OR (Truth)	OR (Truth)	OR (Truth)
Preterm <37 weeks				
Parent/Caregiver Abuse				
Emotional Abuse	0.94 (0.76 - 1.17)	0.39	0.68	0.77
Physical Abuse	1.02 (0.77 - 1.35)	0.74	0.84	0.89
Sexual Abuse	0.99 (0.69 - 1.42)	0.74	0.82	0.86
Non-Parent/Caregiver Sexual Abuse				
Motivated by Non Physical Threat	1.02 (0.76 - 1.37)	0.75	0.85	0.89
Motivated by Physical Force	1.04 (0.74 - 1.45)	0.81	0.90	0.94
Preterm <34 weeks				
Parent/Caregiver Abuse				
Emotional Abuse	0.83 (0.57 - 1.21)	0.31	0.57	0.67
Physical Abuse	0.95 (0.58 - 1.55)	0.66	0.76	0.80
Sexual Abuse	0.93 (0.49 - 1.73)	0.62	0.69	0.73
Non-Parent/Caregiver Sexual Abuse				
Motivated by Non Physical Threat	1.17 (0.73 - 1.88)	0.95	1.05	1.10
Motivated by Physical Force	1.56 (0.96 - 2.53)	1.68	1.78	1.83

Table 8.4 (continued). Corrected Associations Between Abuse and Preterm and Very Preterm

Birth, With Varying Sensitivities and Specificities for Abuse Exposure (Not Assumed to be the

Same Between Cases and Controls)

	Observed Data	PTB/vPTB Sensitivity=.7, Specificity=.95 TERM Sensitivity=.4, Specificity=.95	PTB/vPTB Sensitivity=.9, Specificity=.95 TERM Sensitivity=.6, Specificity=.95
	OR (95% CI)	OR	OR
Preterm <37 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.94 (0.76 - 1.17)	0.19	0.45
Physical Abuse	1.02 (0.77 - 1.35)	0.47	0.62
Sexual Abuse	0.99 (0.69 - 1.42)	0.50	0.62
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.02 (0.76 - 1.37)	0.48	0.63
Motivated by Physical Force	1.04 (0.74 - 1.45)	0.54	0.67
Preterm <34 weeks			
Parent/Caregiver Abuse			
Emotional Abuse	0.83 (0.57 - 1.21)	0.16	0.39
Physical Abuse	0.95 (0.58 - 1.55)	0.42	0.56
Sexual Abuse	0.93 (0.49 - 1.73)	0.42	0.52
Non-Parent/Caregiver Sexual Abuse			
Motivated by Non Physical Threat	1.17 (0.73 - 1.88)	0.60	0.77
Motivated by Physical Force	1.56 (0.96 - 2.53)	1.07	1.31

Child Abuse, Probability of Giving Live Birth, and Bias

One consideration that may affect whether child abuse is related to PTB/vPTB is if child abuse affects the probability of giving birth, and this increased likelihood introduces bias in child abuse-PTB/vPTB associations. The Add Health population only captures births occurring through a woman's Wave 4 visit (between ages of 24-32) and thus includes a disproportionate number of births to young mothers. It is known that child abuse is linked to an increased probability of early childbearing, and this association is observed within the Add Health study population. Exposure to parent/adult caregiver perpetrated abuse was more common in those who had given live birth, as compared to those who had not given live birth (34.05% versus 31.96% for emotional abuse, 14.97% versus 10.70% for physical abuse, and 8.87% versus 6.04% for sexual abuse). Likewise, sexual abuse perpetrated by non-parents/adult caregivers was more common in women with histories of live birth, compared to those who had not given live birth (14.86% versus 9.34% and 10.98% versus 6.73% for sexual abuse motivated by non-physical threats and physical force, respectively).

Since child abuse appears to affect probability of giving birth, it may affect the association between child abuse and PTB if those who experienced abuse and became pregnant had a different (i.e., more severe) experience of abuse than those who experienced abuse but did not become pregnant. One way to examine this is if the severity of abuse differed between those who become pregnant versus those who did not become pregnant. Differences in the frequency of the abuse between the two groups were examined as two sample t-tests (considering the frequency of abuse as an ordinal

variable).   This analysis was only possible for parental/ adult caregiver abuse, as frequency of non-parental/caregiver sexual abuse was not part of the questionnaire.

Results showed that for emotional abuse, the frequency of abuse in those reporting histories of abuse was slightly higher in women who had a live birth, but not statistically significant from those who had not had a live birth (Mean score difference= .11, 95% CI (.01, .23)). Effect sizes for the differences between the two groups were larger and statistically different in the two groups for sexual abuse and physical abuse, respectively (mean score difference between two groups= .40 (95% CI: .10,.70); mean score difference between two groups= 0.22 (95% CI: .01, -0.44).

These analyses suggest that the bias related to increased probability of live birth among adults abused as children is not likely to explain the mostly null and possibly protective associations between abuse and PTB/vPTB observed in these data. One would expect that more frequent abuse translates to a more severe exposure. If women who had given birth had more severe experiences of abuse, this would be expected to induce positive bias in relationships between abuse and pregnancy outcomes such as PTB.

There are two possible reasons for the observed null/borderline protective associations between abuse and PTB/vPTB, in spite of (likely) positive bias induced by the Add Health sampling that included high numbers of pregnancies to young mothers. First, it is possible that despite being statistically significant, the increased frequency of abuse has little meaningful impact, which may be the case given the small effect sizes. The frequency of abuse was assessed on an ordinal scale, so it is difficult to precisely state the interpretation of a one unit change, but most categories reflected a narrow range of frequency of abuse exposures. Thus, the observed mean score differences, which were

all less than .5, are unlikely to reflect large differences in instances of abuse experienced. Alternatively, it is also possible these differences, although small in magnitude, may create meaningful positive bias. However, if that is the case, then this bias must be small in comparison to other biases that would skew the observed associations in a protective/negative direction.

Infection As a Mediator of the Relationship Between Sexual Abuse and Preterm Birth

Findings showed that adult/caregiver sexual abuse perpetrated by physical threats was associated with vPTB. Since vPTB is frequently associated with infection, and child abuse is associated with risky sexual behaviors that may increase the risk of sexually transmitted infections (STIs), we explored the hypothesis that STIs may mediate this relationship. First, relationships between the five types of child abuse were examined with respect to self-reported history of being diagnosed with any of the following infections: chlamydia, gonorrhea, trichomoniasis, genital herpes, syphilis, genital warts, and vaginitis. Each type of abuse was more common among those with STIs: (42.30% versus 30.48% for emotional abuse, 19.95% versus 12.44% for physical abuse, and 12.30% versus 7.02% for sexual abuse). Likewise, sexual abuse perpetrated by non-parents/adult caregivers was more common in women with histories of STI, compared to those who did not have such a history (21.44% versus 11.89% and 17.21% versus 7.52% for sexual abuse motivated by non-physical threats and physical force, respectively). However, history of STI was not associated with PTB or vPTB in this sample. Thus, STI history cannot be a mediator of the association between abuse and PTB/vPTB.

There are two important limitations of these data. First they relied on self-reported infection data, which usually underreports STIs. Second, information about timing of STI infection was not available. If STI had been appropriately treated or occurred after delivery, an association with vPTB would not be expected. Thus, while there was no evidence of STI acting as a mediator, it is also important to note that these data were not ideal for assessing mediation.

Chapter 7 Analyses

Age at Delivery as a Potential Effect Modifier

Age may be an important effect modifier of the relationship between continued smoking and abuse. It is possible that this relationship may differ in women who are relatively younger or older, since younger women may be more likely to smoke in pregnancy and be more resilient to the effects of adverse childhood experiences. Thus, we conducted sensitivity analyses stratified on whether women were pregnant during the Wave 3 interview and Wave 4 interview. Results (tables 5 and 6 below) showed that there was no consistent pattern of associations observed in Wave 3 versus Wave 4, although statistically significant associations were limited to Wave 4.

Table 8.5. Associations (Risk Differences) Between Abuse and Continued Smoking

Among Pregnant Women Who Had Ever Smoked: Wave 3 versus Wave 4 Pregnancies

	Wave 3 Crude RD (95% CI)	Wave 3 Adjusted RD (95% CI)	Wave 4 Crude RD (95% CI)	Wave 4 Adjusted RD (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	0.03 (-0.17, 0.23)	0.02 (-0.18, 0.22)	-0.02 (-0.22, 0.18)	0.02 (-0.16, 0.20)
Physical Abuse	-0.02 (-0.24, 0.20)	-0.03 (-0.25, 0.19)	0.24 (-0.03, 0.51)	0.26 (-0.03, 0.55)
Sexual Abuse	-0.08 (-0.49, 0.33)	-0.08 (-0.51, 0.35)	0.05 (-0.36, 0.46)	0.07 (-0.44, 0.58)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	0.13 (-0.14, 0.40)	0.13 (-0.12, 0.38)	-0.06 (-0.39, 0.27)	-0.05 (-0.36, 0.26)
Motivated by Physical Force	0.17 (-0.14, 0.48)	0.14 (-0.17, 0.45)	0.44 (0.15, 0.73)	0.49 (0.10, 0.88)

Table 8.6. Associations (Risk Ratios) Between Abuse and Continued Smoking Among Pregnant Women Who Had Ever Smoked: Wave 3 versus Wave 4 Pregnancies

	Wave 3 Crude RR (95% CI)	Wave 3 Adjusted RR (95% CI)	Wave 4 Crude RR (95% CI)	Wave 4 Adjusted RR (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	1.05 (0.75, 1.48)	1.04 (0.75, 1.46)	0.94 (0.53, 1.67)	1.07 (0.66, 1.72)
Physical Abuse	0.96 (0.65, 1.43)	0.95 (0.64, 1.41)	1.73 (1.00, 3.01)	1.80 (1.02, 3.17)
Sexual Abuse	0.86 (0.37, 1.99)	0.86 (0.36, 2.05)	1.13 (0.41, 3.16)	1.20 (0.36, 4.01)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	1.24 (0.78, 1.98)	1.25 (0.80, 1.93)	0.83 (0.28, 2.51)	0.86 (0.31, 2.34)
Motivated by Physical Force	1.31 (0.80, 2.14)	1.25 (0.76, 2.07)	2.32 (1.48, 3.65)	2.51 (1.44, 4.36)

Parity analyses

Parity may also be an important predictor of relationships between child abuse and continued smoking among pregnant women. It is possible that women may be more or less likely to alter their behaviors in their first pregnancies relative to second and beyond. Thus, models were also stratified on parity (nulliparous versus multiparous women). No obvious patterns emerged.

Table 8.7. Associations (Risk Differences) Between Abuse and Continued Smoking
Among Pregnant Women Who Had Ever Smoked: Nulliparous vs. Parous

	Nulliparous	Nulliparous	Parous	Parous
	Crude RD (95% CI)	Adjusted RD (95% CI)	Crude RD (95% CI)	Adjusted RD (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	0.13 (-0.11, 0.37)	-0.06 (-0.20, 0.08)	-0.04 (-0.20, 0.12)	0.13 (-0.09, 0.35)
Physical Abuse	0.29 (-0.08, 0.66)	-0.02 (-0.22, 0.18)	0.01 (-0.19, 0.21)	0.36 (-0.03, 0.75)
Sexual Abuse	-0.16 (-0.51, 0.19)	-0.02 (-0.39, 0.35)	0.02 (-0.33, 0.37)	-0.11 (-0.56, 0.34)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	0.12 (-0.21, 0.45)	0.19 (-0.06, 0.44)	0.16 (-0.11, 0.43)	0.11 (-0.22, 0.44)
Motivated by Physical Force	0.16 (-0.13, 0.45)	0.38 (0.16, 0.60)	0.37 (0.17, 0.57)	0.16 (-0.15, 0.47)

Table 8.8. Associations (Risk Ratios) Between Abuse and Continued Smoking Among

Pregnant Women Who Had Ever Smoked: Nulliparous vs. Parous

	Nulliparous Crude RR (95% CI)	Nulliparous Adjusted RR (95% CI)	Parous Crude RR (95% CI)	Parous Adjusted RR (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	1.52 (0.73, 3.16)	0.89 (0.68, 1.17)	0.93 (0.69, 1.26)	1.50 (0.75, 2.98)
Physical Abuse	2.01 (0.97, 4.16)	0.97 (0.67, 1.39)	1.02 (0.71, 1.48)	2.24 (1.12, 4.50)
Sexual Abuse	0.52 (0.08, 3.65)	0.97 (0.48, 1.98)	1.03 (0.54, 1.96)	0.65 (0.08, 5.33)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	1.38 (0.61, 3.11)	1.37 (0.91, 2.07)	1.32 (0.85, 2.06)	1.35 (0.59, 3.07)
Motivated by Physical Force	1.49 (0.79, 2.83)	1.80 (1.30, 2.49)	1.78 (1.29, 2.44)	1.49 (0.74, 2.99)

Analyses for All Wave 3 Women

Due to small sample size in chapter 7, we also completed on analyses of the

relationship between abuse and continued smoking for all women in the Wave 3

interview. There was no overall main effect of abuse on continued smoking among

women in this population, similar to analyses of Wave 3 described previously. When

stratified on depressive symptoms, there was a tendency for women with lower

depressive symptoms to have risk ratios <1 and risk differences <0, similar to results

presented in chapter 6.   However, there was no significant relationship between any

abuse type and continued smoking among women with depressive symptoms.   These

findings suggest that the overall pattern of the relationship between abuse and continued

smoking is the same among pregnant women as the overall population of women.

Table 8.9. Associations (Risk Differences) Between Abuse and Continued Smoking

Among All Wave 3 Study Participants: Stratified on Depressive Symptoms

	No or Minimal Depressive Symptoms	No or Minimal Depressive Symptoms	Low to High Depressive Symptoms	Low to High Depressive Symptoms
	Crude RD (95% CI)	Adjusted RD (95% CI)	Crude RD (95% CI)	Adjusted RD (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	-0.07 (-0.13, 0.01)	-0.08 (-0.14 , -0.02)	0.00 (-0.06 , 0.06)	0.00 (-0.06 , 0.06)
Physical Abuse	-0.12 (-0.22, 0.02)	-0.13 (-0.23 , -0.03)	0.05 (-0.03 , 0.13)	0.05 (-0.03 , 0.13)
Sexual Abuse	-0.02 (-0.14 ,0.10)	-0.02 (-0.16 , 0.12)	0.05 (-0.03 , 0.13)	0.04 (-0.04 , 0.12)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	-0.05 (-0.13 ,0.03)	-0.06 (-0.14 , 0.02)	-0.05 (-0.13 ,0.03)	-0.05 (-0.13 ,0.03)
Motivated by Physical Force	-0.02 (-0.10 ,0.06)	-0.03 (-0.11 , 0.05)	0.01 (-0.07 , 0.09)	0.00 (-0.08 , 0.08)

Table 8.10. Associations (Risk Ratios) Between Abuse and Continued Smoking Among

All Wave 3 Study Participants: Stratified on Depressive Symptoms

	No or Minimal Depressive Symptoms	No or Minimal Depressive Symptoms	Low to High Depressive Symptoms	Low to High Depressive Symptoms
	Crude RR (95% CI)	Adjusted RR (95% CI)	Crude RR (95% CI)	Adjusted RR (95% CI)
Parental/ Caregiver Abuse				
Emotional Abuse	0.91 (0.85 , 0.98)	0.91 (0.84 , 0.98)	1.00 (0.93 , 1.07)	1.00 (0.93 , 1.07)
Physical Abuse	0.85 (0.74 , 0.98)	0.85 (0.73 , 0.98)	1.07 (0.97 , 1.17)	1.06 (0.97 , 1.17)
Sexual Abuse	0.98 (0.83 , 1.15)	0.98 (0.82 , 1.16)	1.06 (0.96 , 1.17)	1.05 (0.94 , 1.17)
Non Parental/ Caregiver Sexual Abuse				
Motivated by Non-Physical Threat	0.94 (0.85 , 1.04)	0.93 (0.84 , 1.03)	0.94 (0.86 , 1.03)	0.94 (0.86 , 1.03)
Motivated by Physical Force	0.97 (0.88 , 1.08)	0.96 (0.87 , 1.06)	1.01 (0.91 , 1.11)	1.00 (0.91 , 1.10)

References

1.   Lash TL, Fox MP, Fink AK. Applying Quantitative Bias Analysis to
      Epidemiologic Data. Springer. 2009

CHAPTER 9

Summary, Implications, and Future Directions

This chapter presents an overall summary of findings, broader implications of research findings, and future research directions.

Overall summary of findings

The goal of this dissertation was to examine whether self-reported maternal exposure to child abuse and neglect is associated with preterm delivery and psychosocial mediators of preterm delivery. Results of this dissertation suggest that child abuse is a common experience and that certain types of abuse, particularly sexual abuse, are associated with long term consequences that affect perinatal outcomes and behaviors. They also suggest that maltreatment is an exposure that may be subject to misclassification, which may be differential with respect to PTB.

Chapters 4 and 5 were devoted to issues pertaining to misclassification of childhood trauma. Overall test-retest reliability was at least moderate for all trauma types except physical neglect. However, for those experiencing certain adverse pregnancy outcomes, there was a tendency to report trauma after delivery but not before; this was not observed among women with healthy pregnancies. Only physical neglect measured after delivery was positively associated with adverse outcomes, and these associations were in the opposite direction of measures collected before delivery.

In chapter 6, only non-parental caregiver sexual abuse motivated by physical threat was associated with vPTB. This association was limited to women whose abuse had an onset after age 9. Additional sensitivity analyses revealed that these mostly null findings are not likely to be related to bias due to the Add Health population's high representation of young mothers.

Finally, in chapter 7, sexual abuse perpetrated by non-parents/caregivers that was motivated by physical force was associated with continued smoking during pregnancy. When stratified by depressive symptoms, positive associations were limited to women with depressive symptomatology.

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Implications of Research Findings

Measurement of Childhood Maltreatment

Chapters 3 and 4 raise concerns about measurement of child maltreatment and suggest that it may be recalled non-differentially, depending on whether a woman has experienced an adverse perinatal outcome. This has implications for the use of certain study designs and argues for the need for prospective cohort studies, as those which measure exposure before outcome may be less subject to bias, but those where exposure is measured after the outcome may yield results that are biased in a positive direction. While cohort studies are often used to assess the effect of psychosocial exposures on preterm birth, this is not universal. Further, even if cohort study designs are used, assessment of abuse can occur after delivery, as was the case in the Add Health dataset.

The strongest evidence for bias in measurement for child maltreatment was for physical neglect.   In some respects, this is assuring.   Some studies have suggested other forms of child abuse, particularly sexual abuse, may be of greater importance to health outcomes in women, including perinatal outcomes, as that has been more consistently linked with adverse health outcomes in studies that have measured multiple types of maltreatment (Cammack, 2011; Noll, 2008; Selk, 2016) . However, despite some studies including diverse forms of maltreatment, neglect is still underrepresented in the literature and some investigators have called for its greater inclusion in maltreatment studies (Stoltenborgh, 2013).   If subsequent studies find effects of neglect on perinatal outcomes, the role of recall bias should be integrated into interpretations of those findings.

Public Health Implications: Screening of Abuse

Although additional work is necessary to confirm causal relationships between abuse and perinatal outcomes and behaviors, these findings suggest that interventions to reduce the impact of adverse childhood experiences upon pregnancy is likely important. In order to conduct interventions, it is necessary to identify women who are affected. An important venue for this identification could involve screening in the context of prenatal or well-woman care.   The American College of Obstetricians and Gynecologists has recommended screening of sexual abuse, which can reduce the impact of these experiences on reproductive health (ACOG, 2011). Findings from this dissertation research provide more support for the screening of sexual abuse, although they also give

support to consideration of screening of other forms of maltreatment. Chapter 7 also demonstrates that consideration of screening may be particularly important among women with depression and/or other forms of psychopathology. However, some investigators have raised concerns about optimal implementation (White, 2016), so it is important to study the feasibility of screening in the context of women's healthcare.

Justice Implications

As mentioned in the first chapter, these findings have important criminal justice implications since maltreatment is not just a health concern, but also a criminal act. Elaboration of the long term effects of abuse in pregnant women may be important to driving policy level interventions aimed at primary and secondary prevention of abuse. Outcomes in maternal child health are often utilized as indicators of population health, hence evidence of pregnancy related outcomes may be important evidence to utilize.

These findings also have social justice implications. The fact that the majority of women who experienced maltreatment did not experience PTB and many did not continue to smoke in their pregnancies suggests that these women were resilient to the effects of abuse, and possibly even experienced positive growth as a result of adverse childhood experiences. Women with histories of abuse are in many respects a marginalized population that faces stigma (Kennedy, 2016). Demonstrating that abused women can be resilient to the effects of abuse and/or experience positive changes could be helpful in decreasing stigma, which may help facilitate more open societal discussion and support for affected women.

Exploration of the role of resilience/and or post-traumatic growth can also be important to furthering social justice because it can provide alternate venues for secondary prevention. Although prevention of childhood maltreatment is a laudable goal and an important area to focus on policy-wise, it is not realistic to expect that every case of child maltreatment can be prevented. Thus, studying factors that allow investigators to better understand what makes women develop resilient or even positive responses to trauma can help affected individuals live healthy lives.

Future Research Directions

The findings of this dissertation suggest the importance of several future avenues of research. First, a more through understanding of bias in reporting of childhood abuse and neglect around pregnancy is clearly needed.   Lack of an understanding of factors that may influence accurate reporting of maltreatment around the time of pregnancy is a fundamental threat to the validity of all studies evaluating associations between child abuse and birth outcomes, including preterm birth.   This can be accomplished via multiple approaches. First, studies similar to those in chapters 4 and 5 that utilize a larger sample size and are conducted in the general population are important to confirming these findings.   A second area that would build on this research would involve use of maltreatment measures that represent more of a gold standard. Although there is no universally accepted true gold standard for child maltreatment, some have suggested that combining multiple forms of measurement may be more ideal (Kendall-Tackett, 2004). For example, although abuse derived from CPS reporting is relatively

rare, one could enhance CPS reports by screening those without such reports through self- report to establish a more accurate unexposed sample.

The results of this dissertation also clearly highlight the need for longitudinal studies.   As discussed earlier, longitudinal studies are critical for exploring other ways of measuring child abuse (besides retrospective self-report). It is also important for establishing temporal sequencing of mediators through which child abuse may lead to preterm birth. This could address limitations of chapter 7, where smoking data measured in the immediate preconception period would be useful for disentangling bidirectionality between smoking and depressive symptoms. Cost is an obvious deterrent to conducting longitudinal studies with prospective measures of child maltreatment, but such studies are needed to infer causality.

In studying the role of abuse on preterm birth risk, this dissertation suggests that measurement of aspects of abuse other than frequency would be useful. Practical to use measures that capture timing of maltreatment are particularly uncommon. While a recently developed measure has assessed timing of abuse (Teicher, 2015); it is lengthy, and thus likely not feasible to use in the context of perinatal epidemiology studies; research should focus on the development of validated measures that can be used in such studies.   Another aspect of abuse in need of further investigation is perpetrator type, which most commonly used scales fail to distinguish.   This dissertation only addresses different perpetrators for one type of maltreatment (sexual abuse), but an exploration of the role of perpetrator type with respect to emotional and physical abuse would also be useful.   Last, studies should also consider stratifying PTB according to underlying etiology since it is possible that certain etiologies may be more strongly linked with

exposure to child maltreatment, although the current literature does not suggest any one particular pathway that may be especially important.

Finally, future studies should further explore the potential effect modifying roles of resilience and post-traumatic growth. This can be addressed in two ways. Sampling of different populations that may be relatively more or less prone to the effects of maltreatment and/or more likely to experience post-traumatic growth (e.g., studies of abuse in a population that had dropped out of high school would be an important contrast with the Add Health study population where enrollment was contingent on school enrollment) could be useful. Second, investigators should also consider utilizing more direct measures of resilience and posttraumatic growth (e.g., Posttraumatic Growth Inventory; Tedeschi, 2006) within their study populations.

Conclusions

This dissertation illustrates the complexity of the relationship between child maltreatment and perinatal outcomes. Future studies that build upon the themes of misclassification and resilience are important to making further meaningful contributions to the literature. Considering the high prevalence of childhood maltreatment, this dissertation also has significant public health, criminal, and social justice implications that have the potential to affect many women and their children.

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