PRENATAL INTIMATE PARTNER VIOLENCE AND DEPRESSION DURING CHILDHOOD: THE ROLE OF PHYSIOLOGICAL STRESS RESPONSE DYSREGULATION

By

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ABSTRACT

PRENATAL INTIMATE PARTNER VIOLENCE AND DEPRESSION DURING CHILDHOOD: THE ROLE OF PHYSIOLOGICAL STRESS RESPONSE DYSREGULATION

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Objective: This study investigates the influence of exposure to intimate partner violence (IPV) during pregnancy on offspring depressive problems during childhood, examining HPA axis dysregulation (via stress-induced levels of salivary cortisol) as a mediating mechanism. This research is guided by the "fetal programming" theory, which proposes that the environmental conditions during pregnancy can exert long-term neural adaptations and influence later physiological and psychological functioning. In addition, trauma theory supports the role of IPV as a particularly deleterious influence, due to its interpersonal and chronic nature, and well-established associated neuroregulatory deficits. Finally, consistent with developmental psychopathology, a number of factors at the individual and family levels were examined, and interactions between different levels of risk and protection were explored. Previous empirical studies support the proposed pathway: prenatal stress predicts child temperamental difficulties, internalizing symptoms, and HPA axis dysregulation. However, only one study to date has reported a link between prenatal stress, HPA axis functioning, and depression. No study to date has evaluated the distinct effect of prenatal IPV on long-term offspring neuroendocrine and psychological outcomes. **Method:** Participants were 119 children followed longitudinally since pregnancy, who were about 10 years old for the present assessment. Questionnaires assessed IPV, maternal mental health, maternal early parenting, family history of depression, and income. A coded laboratory task measured maternal warmth towards their child during infancy. HPA axis dysregulation was assessed via salivary cortisol levels before, 20 minutes after and 40

minutes after the Trier Social Stress Task for Children. Child depressive symptoms were assessed through maternal and child reports, using questionnaires and a semi-structured clinical interview (K-SADS-PL). **Results:** Structural Equation Modeling, Latent Class Analysis, Logistic Regression, and MANCOVA were used for hypothesis testing. Exposure to IPV during pregnancy and current exposure to IPV predicted higher salivary cortisol output. Depression during childhood was predicted by IPV during pregnancy, maternal mental health during pregnancy, early parenting, current exposure to IPV, current maternal mental health, gender, and cortisol levels; however, different predictors were significant for mother-reported and child-reported depressive symptoms. Gender and family history of depression moderated the relationships between child depressive symptoms and prenatal, postnatal, and familial risk. **Discussion:** Findings support the "programming hypothesis" and the role of prenatal IPV as a unique risk factor associated with HPA axis functioning and childhood depression, over and above the effects of other prenatal stressors and postnatal adversity. Results support the multi-determined nature of child depressive symptoms, as prenatal and postnatal factors at the individual and family levels significantly influenced outcomes. This is the first study to link prenatal IPV exposure with HPA axis dysregulation and depressive symptoms. Future research should replicate the present findings, using multiple indices of HPA axis functioning and examine whether this mechanism differentiates distinct subgroups of depressed children.

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The present study examines prenatal exposure to intimate partner violence (IPV) as a risk factor for children's later psychological problems, examining the specific link between exposure to IPV in *utero* and childhood depressive problems, mediated via neuroendocrine abnormalities in children's physiological response to stressors.

This research is guided by the "fetal programming" theory (Barker, 1998; Beydoun & Saftlas, 2008; Huizink, Mulder, & Buitelaar, 2004; O'Connor, Heron, Golding, Beveridge, & Glover, 2002; Talge, Neal, & Glover, 2007), which posits that the prenatal conditions determine fetal growth and development, producing long-term physiological adaptations. The relevance of the prenatal environment can be understood using the concept of "sensitive periods" or phases of greater susceptibility (Bateson & Hinde, 1987), during which the fetus undergoes rapid changes in the developing neural structures and is most responsive to environmental conditions. The sensitive period begins in *utero* and, due to the plasticity of the young brain, extends into infancy and beyond (Cushing & Kramer, 2005).

Fetal programming via retarded fetal growth has been associated with a number of problems during adulthood, including diabetes, coronary heart disease, and hypertension (Barker, 1998). The Dutch Hunger Winter Study found that maternal malnutrition during pregnancy, preceded and followed by adequate nutrition, was associated with increased risk for breast cancer, coronary heart disease, glucose intolerance, stress sensitivity, and obesity (Roseboom, de Rooij, & Painter, 2006). However, these adaptations are aimed to ensure offspring survival in the short-term, and can promote long-term adaptation to similar adverse conditions in postnatal life. For example, the Leningrad Siege Study found that maternal malnutrition during pregnancy was not associated with glucose intolerance, dyslipidaemia, hypertension, or cardiovascular

disease in adulthood in the context of chronic poor nutrition prior to pregnancy and during the first few years of life (Stanner & Yudkin, 2001).

A number of authors (Maccari et al., 2003; Talge et al., 2007) have proposed that exposure to adversity during pregnancy also has important implications for psychological outcomes; structural and functional changes in the central nervous system (CNS) can underlie later behavioral and emotional regulation deficits and result in psychiatric symptoms. Boyce and Ellis (2005) propose that the prenatal environment serves as a template for the environmental conditions that the fetus will encounter after birth and influence the development of stress reactivity: high reactivity is developed to promote offspring survival in a threatening environment, with high levels of circulating stress hormone (i.e., cortisol) protecting against immune, infectious, and inflammatory diseases (Kapcala, Chautard, & Eskay, 1995). However, the frequent activation of the offspring stress response results in chronic tissue exposure to high levels of cortisol, potentially conducive to deficits on brain structure and function, and abnormalities in the physiological response to stressors.

An elevated response to stressors may be a marker for impaired threat signal detection or inefficient regulation of pleasure/motivation systems among depressed children (Goodyer, 2008), and a result of the interplay between a genetic vulnerability and chronic activation of the stress response via frequent adversity. Importantly, addressing the earliest observable individual differences that convey risk for psychopathology may promote competencies during early life and provide the building blocks for subsequent adaptation, buffering the impact of later adversity (Sroufe, Carlson, Levy, & Egeland, 1999). Research consistently identifies early precursors to later internalizing symptoms (Bayer, Hiscock, Ukoumunne, Price, & Wake, 2008; Bayer & Sanson, 2003; Gladstone & Parker, 2006) and have found that an abnormal physiological

response to stressors can precede the development of depressive symptoms (Young, Vazquez, Jiang, & Pfeffer, 2006). Delineating specific pathways that lead from early (prenatal) risk to depressive problems during childhood is essential for successful targeted prevention and treatment efforts.

The present study is also guided by complex trauma theory, which posits that exposure to trauma is qualitatively different from exposure to stress and results in developmental deficits related to regulatory capacities, consistent with the multiple and non-specific symptoms experienced after chronic traumatization (Cloitre et al., 2009). Specifically, complex trauma theory proposes lasting changes in the victim's central nervous system (CNS). This theory supports the unique role of IPV during pregnancy on the victim's neuroendocrine functioning, given its interpersonal and chronic nature; the resulting stress regulation deficits are expected to be above and beyond the victim's psychiatric symptoms. Women's neuroregulatory deficits during pregnancy, in turn, influence fetal CNS development.

Importantly, mothers develop internal representations and attitudes towards their fetus during pregnancy (Stern, 1995; Zeanah, Keener, & Anders, 1986). These representations are largely influenced by exposure to IPV, as the violence occurs in the context of a significant attachment relationship, influencing the women's capacity for other healthy attachments (including attachment to her baby). Research supports this notion: Huth-Bocks, Levendosky, Theran, and Bogat (2004) found that women who experienced IPV during pregnancy had significantly more negative prenatal representations of their infants and of themselves as mothers than women who had not experienced violence during pregnancy. In addition, prenatal representations predicted attachment relationships 1 year postpartum among this sample (Huth-Bocks, Levendosky, Bogat, & von Eye, 2004). Research has also demonstrated that these

internal representations during pregnancy predict maternal parenting behaviors, such that negative representations are associated with more controlling and hostile behaviors towards the infant among abused women (Dayton, Levendosky, Davidson, & Bogat, 2010).

Finally, developmental psychopathology theory also informs this research. This theory proposes that children's behavior is influenced by multiple determinants at the child, family and societal levels, rather than being the result of a single precipitating factor (Finkelhor & Kendall-Tackett, 1997). The basic principles of *multifinality* and *equifinality* (Cicchetti & Rogosch, 1996) suggest that a specific vulnerability may result in a number of different psychiatric problems or resilient outcomes, while a specific psychiatric disorder may be caused by a variety of different etiological pathways. Identification of specific psychiatric vulnerabilities at the genetic, epigenetic, neurobiological, familial and social levels, as well as the mechanisms through which these vulnerabilities evolve into specific psychiatric symptoms, is a major focus of the field (Beauchaine, Neuhaus, Brenner, & Gatzke-Kopp, 2008).

The aim of this study is to evaluate the role of prenatal exposure to IPV as an early risk factor for depressive problems during school age. In addition, abnormalities in one of the physiological systems that regulate the response to stressors (Hypothalamic-Pituitary-Adrenal axis- HPA), as indexed by basal and stress-induced levels of cortisol, are explored as a mechanism that accompanies the expression of depressive symptoms in the context of early risk. A model that integrates the early risk associated with exposure to IPV during the prenatal period and a number of well established factors that convey vulnerability for childhood depression (i.e., family history of internalizing problems, maternal mental health, maternal early parenting, IPV exposure during childhood, low income) was proposed and evaluated. In addition, abnormalities in basal and stress-induced levels of cortisol, as well as empirically derived patterns of response

to a stressor were explored and associations with prenatal and lifetime risk and protective factors were tested. Following the programming hypothesis, HPA axis function was examined as a mediator for the negative effect of prenatal risk. Finally, gender and family history of depression were examined as factors that may heighten or moderate the impact of early and lifetime biological, familial, and environmental risk.

The Effects of Exposure to IPV and Increased Stress during Pregnancy

IPV Definition and Prevalence

Intimate partner violence (IPV) is defined by the Centers for Disease Control and Prevention (2008) as physical, sexual, or psychological harm by a current or former partner or spouse. Saltzman, Fanslow, McMahon, and Shelley (1999) describe four domains or types of IPV, including physical violence, sexual violence, threats of physical and sexual violence, and psychological violence. Physical violence refers to the intentional use of physical force with the potential for causing harm, ranging from scratching and pushing to punching, burning, or using a weapon. Sexual violence includes attempts at abusive sexual contact through the use of physical force or coercion. Threats of physical or sexual violence include words, gestures, or weapons that communicate threat of harm. Psychological violence involves harm to the victim via threats or coercive tactics, including humiliating, controlling and isolating the victim (Saltzman et al., 1999). For the purposes of this research, IPV will be defined as violent threats and physically and sexually aggressive behaviors of a man towards his female romantic partner (e.g., pushing, hitting, and threatening with a weapon).

IPV is a significant public health concern; national surveys and estimates based on probability samples indicate that between 20% (Tjaden & Thoennes, 2000) and 34% (Frieze, Knoble, Washburn, & Zomnir, 1980) of women experience physical abuse from a romantic

partner during their lifetime. Moreover, more than half of women experiencing IPV live with children below age 12 (Fantuzzo, Boruch, Beriama, Atkins, & Marcus, 1997) and more than 10 million children in the U.S. are exposed to IPV (i.e., see, hear, are directly involved in, or experience the aftermath of physical and sexual violence to their caregivers; Edleson, 1999). Importantly, IPV during pregnancy appears to be highly prevalent with estimates that range from 1% to 20% when all types of abuse are included (i.e., physical, emotional, and sexual; Gazmararian et al., 1996). Large variability between prevalence estimates may be due to researchers using different definitions of abuse or different data collection methods.

Consequences of IPV Exposure for Women and Children

It is widely recognized that IPV results in a host of physical and psychological problems for the female victims (Golding, 1999; Pico-Alfonso et al., 2006) and their children (Kitzman, Gaylord, Holt, & Kenny, 2003). Women who experience IPV report higher levels of psychopathology and distress and are more likely to display depression, posttraumatic stress disorder (PTSD), anxiety disorders, and alcohol abuse (Dansky, Byrne, & Brady, 1999; DeJonghe, Bogat, Levendosky, & von Eye, 2008; Laffaye, Kennedy, & Stein, 2003; Mourad, Levendosky, Bogat, & von Eye, 2008; Tolman & Rosen, 2001). The amount of IPV experienced and the victim's perceptions of the abuse predict the degree of impairment she experiences (Bogat, Levendosky, Theran, von Eye, & Davidson, 2003; Golding, 1999; Martinez-Torteya, Bogat, Levendosky, von Eye & Davidson, 2009; Vogel & Marshall, 2001). Exposure to IPV during pregnancy has been less well studied, but findings suggest increased risk for psychological and physical problems for the pregnant woman, including injuries (Taggart & Mattson, 1996), depression and PTSD (Varma, Chandra, Thomas, & Carey, 2007; Zareen, Majid, Naqvi, Saboohi, & Fatima, 2009).

In addition to increased mental health problems, neuroendocrine dysregulation (as indexed by levels of salivary or plasma cortisol) is also common among IPV victims and suggests deficits within the stress-response systems. Lower levels of morning cortisol (Griffin, Resick, & Yehuda, 2005; Seedat, Stein, Kennedy, & Hauger, 2003), higher levels of evening cortisol (Pico-Alfonso, Garcia-Linares, Celda-Navarro, Herbert, & Martinez, 2004), and increased daily cortisol output (Inslicht et al., 2006) have been reported among women exposed to IPV. The resulting flattened daily cortisol pattern is different from the expected circadian profile of gradual decrease from morning to evening, which may represent chronically high levels of hormone output that are not effectively adapting to environmental changes (e.g., the natural stressor of waking up). In addition, IPV victims display inefficient termination of the stress response (i.e., slower return to baseline levels after stress; Griffin et al., 2005), which results in longer brain exposure to high levels of cortisol. During pregnancy, IPV has been associated with higher levels of afternoon resting salivary cortisol (Valladares, Pena, Ellsberg, Persson, & Hogberg, 2009), suggesting abnormal response to stressors. Increased cortisol levels and prolonged response are typically associated with depressive symptoms (Burke, Davis, Otte, & Mohr, 2005); however, even when women's depression levels are statistically controlled, the relationship between IPV and neuroendocrine dysregulation is maintained, suggesting a direct association between exposure to IPV during pregnancy and the victim's physiological stress response. Maternal biological and psychological functioning shape the environment that young children are exposed to, contributing to the well-known detrimental impact of IPV exposure on children.

Exposure to IPV negatively influences children's psychological and neuroendocrine development (Edleson, 1999; Wolfe, Crooks, Lee, McInthyre-Smith, & Jaffe, 2003). Increased

risk for internalizing (i.e., anxiety, depression, and trauma symptoms) and externalizing (i.e., aggression, defiance, inattention) problems during infancy and childhood (Bogat, DeJonghe, Levendosky, Davidson, & von Eye, 2006; Grych, Jouriles, Swank, McDonald, & Norwood, 2000; Jarvis, Gordon, & Novaco, 2005; Martinez-Torteya, Bogat, von Eye, & Levendosky, 2009; Sternberg, Baradaran, Abbott, Lamb, & Guterman, 2006) have been reported, with medium effect sizes found in meta-analyses (Evans, Davies, & DiLillo, 2008; Wolfe et al., 2003). Exposure to IPV during childhood is also associated with HPA axis dysregulation; Saltzman, Holden, and Holahan (2005) reported that school-age children exposed to IPV display higher levels of resting salivary cortisol, as compared to non-exposed children. Children's adaptation to family violence is not only determined by the nature of the violent events (e.g., frequency and severity), but also by the individual and environmental resources available to offer protection and support (Finkelhor & Kendall-Tackett, 1997; Martinez-Torteya et al., 2009). Specifically, in the context of internalizing problems, children's perceptions of threat and negative affect in response to marital conflict (not specifically IPV) are predictive of increased symptoms (Rhoades, 2008). Davies, Sturge-Apple, Cicchetti, and Cummings (2008) have suggested that elevated levels of cortisol in response to stress are a marker for increased distress when children are exposed to interparental conflict, suggesting that IPV may result in depressive symptoms via the effects of heightened physiological and affective reactivity to adversity.

Although studies demonstrate that exposure to IPV results in deleterious outcomes as early as infancy (Bogat et al., 2006), little research has examined the association between fetal exposure to IPV and later offspring development. There is consistent evidence that prenatal IPV results in a number of fetal insults (Saltzman, 1990), increasing risk for perinatal death, pre-term delivery, and low birth weight (Coker, Sanderson, & Dong, 2004; Huth-Bocks, Levendosky, &

Bogat, 2002). The consequences of exposure to IPV during pregnancy extend after the pre- and perinatal periods. For example, IPV during pregnancy is associated with more difficult infant temperament (Quinlivan & Evans, 2005), as well as increased internalizing and externalizing problems during infancy (Levendosky, Leahy, Bogat, Davidson, & von Eye, 2006; Martinez-Torteya, Field, Bogat, Levendosky, Davidson, & von Eye, 2009). However, these findings are solely based on maternal reports of IPV and children's outcomes, and using multiple methods or reporters may increase the external validity of results. In addition, studies that evaluate the long-term biopsychosocial impact of exposure to prenatal IPV are lacking. Research examining maternal stress during pregnancy illustrates the mechanisms that may lead to psychological problems via the physiological systems responsible for the stress response, over and above exposure to environmental adversity after birth.

Prenatal Stress and Offspring Outcomes

A number of studies have explored the consequences of exposure to different types of stress during pregnancy, including traumatic stress, chronic stress, and maternal distress. Findings are reviewed in the following sections.

Traumatic Stress

Research exploring the impact of traumatic stress on pregnant women and their offspring is sparse. Landrigan et al. (2008) reported that pregnant women exposed to the World Trade Center attacks on 9/11/2001 had higher rates of intrauterine growth restriction, more infants with low birth weight, and shorter gestation than unexposed mothers. Similarly, Xiong et al. (2008) reported that pregnant women who endorsed more disaster-related experiences during hurricane Katrina (e.g., walking through floodwaters, having a loved one die) had more frequent preterm births and more low birth weight offspring compared to women with few or no disaster-related

experiences. Interestingly, these differences were not dependent on women's concurrent mental health symptoms, including PTSD or depression. Prenatal exposure to traumatic stress can adversely impact the development of the offspring during early childhood; Laplante et al. (2004) reported that exposure of pregnant women to a natural disaster (Quebec ice-storm) predicted worse intellectual and language skills of offspring at age 2. However, research exploring the psychological outcomes during childhood after exposure to traumatic stress in *utero* is still needed. Only one study to date has examined the impact of traumatic stress during pregnancy on offspring HPA axis regulation; Huizink et al. (2008) reported increased cortisol levels among adolescents exposed to a man-made disaster in *utero*, suggesting HPA axis hyperactivity. Taken together, findings indicate that traumatic stressors during pregnancy are associated with important developmental and neurobiological deficits.

Chronic Stressors: Stressful Life Events, Maternal Perceived Distress, Depression, and Anxiety

Chronic stress during pregnancy, assessed via exposure to stressful events or maternal stress-induced psychological symptoms, predicts numerous psychological difficulties early in life. Stressful life events and maternal subjective report of perceived stress during pregnancy predict infant temperamental difficulties (Bergman, Sarkar, O'Connor, Modi, & Glover, 2007; Mohler, Parzer, Brunner, Wiebel, & Resch, 2006), while higher maternal distress during pregnancy (i.e., more depression and/or anxiety) predicts multiple early deficits, such as attention regulation problems (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005; Huizink, de Medina, Mulder, Visser, & Buitelaar, 2002), increased behavioral reactivity to novelty (Brouwers, van Baar, & Pop, 2001; Davis et al., 2007), and increased negative affect (Huot, Brennan, Stowe, Plotsky, & Walker, 2004). The effects of early behavioral and emotional

dysregulation are maintained during toddlerhood and associated with increased externalizing problems (Gutteling et al., 2005).

The effects of stress during pregnancy are also apparent in the long-term. Prospective reports of maternal pregnancy distress (i.e., depression and anxiety symptoms) predicted negative emotionality and inhibition at age 5 (Martin, Noyes, Wisenbacker, & Huttunen, 1999), emotional and conduct problems at age 4 (O'Connor et al., 2002) and age 7 (O'Connor et al., 2005), as well as anxiety at age 8 (van den Bergh & Marcoen, 2004). In their prospective longitudinal study, van den Bergh, van Calster, Smits, van Huffel, and Lagae (2008) reported an association between maternal prenatal anxiety and offspring depressive symptoms during adolescence. Studies using retrospective report have also found associations during adolescence; for example, Allen, Lewinsohn, and Seeley, (1998), reported that a Major Depressive or Dysthymic Disorder diagnosis before age 16 was associated with poor maternal emotional health during pregnancy.

Prenatal stress is also associated with HPA axis abnormalities during infancy and childhood, as measured via basal and stress-induced cortisol levels (for review see Glover, O'Connor, & O'Donnell, 2010). Tollenaar, Beijers, Jansen, Riksen-Walraven, & de Weerth (2011) found that pregnancy-specific anxiety predicted a dysregulated response to stressors during infancy. However, this response depended on the age of evaluation and the stress-induction task used, with increased cortisol response after a bathing task with 5-week-old infants and a blunted cortisol response after a vaccination task at 5 weeks and a separation task at 12 months. In contrast, most studies have replicated cortisol hypersecretion in the context of prenatal stress, including higher baseline cortisol levels during infancy (Brennan et al., 2008), heightened cortisol response to a "still face" stress-induction task during infancy (Grant et al.,

2009), higher cortisol levels in reaction to the first day of school at age 5 (Gutteling, De Weerth, & Buitelaar, 2005), and higher awakening cortisol levels at age 10 (i.e., natural stressor; O'Connor et al., 2005). Prenatal stress continues to impact the offspring's HPA axis functioning in the long-term. Van den Bergh et al. (2008) reported an association between maternal anxiety during pregnancy and adolescents' afternoon cortisol levels, while Entringer, Kumsta, Hellhammer, Wadhwa, and Wust (2009) showed that healthy young adults whose mothers experienced stressful life events during pregnancy had a larger increase in stress-induced plasma cortisol levels, as compared to controls.

Taken together, findings indicate that stressful life events, perceived stress, and stress-induced distress during pregnancy increase temperamental risk and behavioral/emotional problems during infancy, childhood, and adolescence as well as HPA axis dysregulation. Many of these findings were significant over and above the effects of demographic, obstetric, antenatal, and postnatal factors, emphasizing the unique effect of prenatal stress. Results have been replicated using different methods: some studies use cross-sectional designs, which allow researchers to recruit more targeted populations (e.g., children experiencing a specific vulnerability), although findings may be affected by recollection biases. Other studies used prospective longitudinal designs, which allow for a potentially more accurate assessment of stressors during pregnancy, but tend to follow participants for a relatively short period of time (infancy or early childhood) and recruit large community samples with low rates of exposure to traumatic stressors or psychiatric problems.

Studies have also used different conceptualizations for prenatal stress. Importantly, Bergman et al. (2007) found that marital conflict during pregnancy (i.e., serious arguments with partner, separated/divorced, partner was emotionally cruel) was the prenatal life event most

highly correlated with temperamental difficulties during infancy, whereas events such as serious accident, illness, financial problems, and daily hassles did not predict infant outcomes. These results suggest that some stressors are more likely to be associated with deleterious outcomes than others and provide support for the relevance of partner conflict during pregnancy. Trauma Theory suggests that IPV may be more deleterious than other stressful experiences, because it occurs in the context of an intimate relationship, increasing the victim's isolation, guilt, shame, and negative self-cognitions (Calvete, Estevez, & Corral, 2007; Murphy & Hoover, 1999; Street, Gibson, & Holohan, 2005; Walker, 1984). In addition, the chronic pattern of victimization experienced by victims is likely to be associated with lasting biological neuroregulatory deficits for women (Cloitre et al., 2009). Lastly, IPV during pregnancy influences the woman's relationship with the developing fetus through the influence of violence in maternal representations of herself and her baby (Huth-Bocks, Levendosky, Theran, et al., 2004) which will shape the mother-child attachment relationship (Huth-Bocks, Levendosky, Bogat, et al., 2004) and maternal parenting behaviors (Dayton et al., 2010). Thus, exposure to IPV in *utero* is hypothesized to increase risk for emotional and behavioral problems during childhood.

Most studies to date have focused on prenatal stress as a risk factor for general temperamental difficulties or maladaptation, rather than delineating its relationship with specific psychiatric disorders. Unfortunately, this perspective provides little information about prevention efforts or mechanisms of risk for individual children. In contrast, a disorder-specific or person-oriented perspective proposes that there may be specific mechanisms that result in psychiatric symptoms for a subgroup of children. Aggregating all subjects in a single group may misrepresent relationships between variables in significant ways, while identification of empirically derived homogeneous subgroups may help clarify specific within-group patterns of

association (von Eye & Bergman, 2003). A disorder-specific model was proposed by van den Bergh et al. (2008) who assessed the effect of prenatal maternal anxiety on adolescent depressive symptoms. This model is consistent with the early behavioral characteristics reported by prenatal stress research, including difficult temperament, high levels of negative affect, and high levels of internalizing symptoms. In addition, these authors proposed mediation via HPA axis dysregulation, which is consistent with the biological correlates found among both depressed children and those exposed to stress in *utero*. The following sections will address the role of offspring stress response and a specific pathway from pregnancy IPV to HPA axis abnormalities and depressive problems during childhood.

Prenatal Stress Exposure and Offspring Stress Response

The Stress Response

Psychosocial stress involves 4 main elements: the stimulus (environmental or internal); subjective appraisals of the stimulus; coping/adaptation responses; and consequences (Kaplan, 1996, pg. 7). The stimuli may vary in terms of their number, frequency, intensity, and duration, and these characteristics will influence the individual's appraisals and response. Subjective appraisals or cognitive interpretations of a potential stressor are directly associated with the individual's emotional distress (Lazarus & Folkman, 1984). Primary appraisals refer to the evaluation of the significance, relevance, or impact of a stimulus, while secondary appraisals refer to an evaluation of the individual's resources or ability to manage effectively a potentially stressful situation, or coping resources (Lazarus & Folkman, 1984). Environmental stressors elicit a physiological and psychological stress reaction only when they are interpreted as salient to the individual's well being and appraised as threatening, harmful, challenging, or surpassing the individual's resources. The appraisal of stressors initiates responses to reduce emotional

distress, but unsuccessful attempts can increase feelings of fatigue, hopelessness, and depressed affect (Kaplan, 1996, pg. 10).

The stress response consists of a set of adaptive physiological and behavioral changes, such as increased heart rate and blood pressure, inhibition of vegetative functions, and activation of fight/flight responses that are designed to prepare the organism to face an environmental challenge or threat (Boyce & Ellis, 2005; Meyer, Chrousos, & Gold, 2001). The physiological stress response system is constituted by two interdependent systems: the Hypothalamic-Pituitary-Adrenal (HPA) axis and the Sympathetic-Adrenomedullary (SA) system (Boyce & Ellis, 2005; Gunnar & Quevedo, 2007). These systems are interrelated and communicate with the amygdala, anterior cingulate cortex, medial prefrontal cortex, and the dopaminergic system, which are implicated in regulation of fear, anxiety, emotional memory, reward and pleasure, as well as behavioral and affective flexibility (Meyer et al., 2001).

The HPA axis consists of the hypothalamus, the anterior pituitary, and the adrenal cortex, which secrete corticotropine releasing hormone (CRH), arginine vasopressin (AVP), adrenocorticotropic hormone (ACTH), B-endorphin (B-E), and glucocorticoid hormones (i.e., cortisol in humans). The HPA axis initiates a stress response after receiving information from the amygdala, hippocampus, and the autonomic nervous system by increasing the release of CRH and AVP from the hypothalamic paraventricular nuclei into the pituitary (Gunnar & Quevedo, 2007). CRH stimulates ACTH and B-E release from the pituitary gland into the circulatory system, and onto the adrenal cortex, where secretion of cortisol is stimulated. Cortisol is released into the body and the brain, inducing changes in blood pressure, glucose metabolism, growth, and reproduction (Meyer et al., 2001), as well as cognition, memory, and emotion (Cicchetti & Rogosch, 2001).

This stress-induced increase in blood cortisol levels is down-regulated through an inhibitory negative-feedback loop. Cortisol binds to the hippocampal mineralocorticoid (MR) or Type 1 receptors and glucocorticoid (GR) or Type 2 receptors; increased binding exerts an inhibitory effect in production and release of CRH and ACTH, which results in a return to baseline cortisol levels and termination of the HPA stress response (Gunnar & Quevedo, 2007). An efficient HPA response to stressors is characterized by a rapid increase in release of CRH, ACTH, and cortisol after stressful stimuli, and a rapid return to the baseline state of homeostasis once the stressor is terminated, through the inhibitory effects of hippocampal receptors (Talge et al., 2007; Herbert et al., 2006). Effective termination of CRH and ACTH secretion limits tissue exposure to cortisol, minimizing its deleterious catabolic, lipogenic, antireproductive, and immunosuppressive effects (Charmandari, Tsigos, & Chrousos, 2005). The HPA axis functioning has a typical circadian rhythm of cortisol secretion, with highest levels during the morning that gradually decrease throughout the day (Herbert et al., 2006).

The Programming Role of Cortisol

The development and regulation of the HPA axis is influenced by the individual's genetic make-up and environmental factors (Ellis, Jackson, & Boyce, 2006). The "programming hypothesis" proposes that fetal nervous system development is shaped by the uterine environment, in order to match the prenatal environmental demands and increase the chance of successful coping in the postnatal environment (Boyce & Ellis, 2005). In this manner, the prenatal period, during which the fetus undergoes rapid brain development, can set the foundation for the regulation of the stress response later on (Maccari et al., 2003; Huizink et al., 2004; Talge et al., 2007).

Lupien, McEwen, Gunnar, and Heim (2009) propose that the impact of increased stress during pregnancy is mediated via fetal exposure to high levels of cortisol in *utero* and consequent dysregulation of the offspring's HPA axis activity. Barbazanges, Piazza, LeMoal, and Maccari (1996) have shown that the effects of prenatal stress on offspring's depressive-like behaviors and heightened HPA axis response to stressors are dependent on increased glucocorticoid secretion from the mothers, as the behavioral and neuroendocrine effects of prenatal stress are not observed among offspring of adrenalectomized rats, who cannot produce higher levels of glucocorticoids after prenatal stressors. In addition, repeated administration of glucocorticoids to undisturbed pregnant females results in HPA axis dysregulation of the offspring among both rodents (Welberg, Seckl, & Holmes, 2001) and rhesus monkeys (Uno et al., 1994). This research clearly demonstrates a direct relationship between exposure to increased levels of cortisol in *utero* and behavioral or neuroendocrine deficits after birth.

Animal studies provide strong evidence for the "programming" role of increased glucocorticoid exposure in *utero.* However, important considerations should be noted when extrapolating the results of animal studies to humans. The timing of physiological development is different in animals and humans. Among primates, maximal brain growth and neuroendocrine maturation occurs during gestation, while much of the rodent's brain and neuroendocrine development occurs after birth. For example, rat embryonic days 11-21 are comparable to human embryonic weeks 4-16, while the rat neurodevelopment at postnatal day 7 to 13 is equivalent to that of the human brain at birth (Clancy, Finlay, Darlington, & Anand, 2007). With these caveats, animal studies can provide useful insights into specific mechanisms of risk transmission, as laboratory manipulations can help isolate specific risk processes from confounding factors that are commonly present in human studies.

Although glucocorticoid manipulations are not possible among human populations, correlational research provides support for the link between maternal HPA axis functioning during pregnancy and offspring behavioral outcomes. High baseline and awakening levels of maternal cortisol during late pregnancy have been associated with heightened reactivity, more irritability, more negative affect, and difficult temperament during infancy (Davis et al., 2007; De Weerth, van Hees, & Buitelaar, 2003). The effects of high levels of maternal cortisol during pregnancy seem to be maintained during early childhood. Wadhwa, Sandman, and Garite (2001) reported an association between high maternal baseline cortisol levels during late pregnancy and infant difficult temperament at 3 years of age.

Two potential mechanisms of risk transmission have been proposed. One is maternal stress-induced dysregulation of the HPA axis during pregnancy, resulting in higher levels of maternal cortisol output. Consistent with this hypothesis, elevated cortisol levels have been found in women exhibiting psychological distress during pregnancy (Diego et al., 2006; Field et al., 2004; Field, Hernandez-Reif, Diego, Figueiredo, & Schanberg 2006). Importantly, HPA axis dysregulation in the context of traumatic stress during pregnancy also has been demonstrated among IPV victims (Valladares et al., 2009). Correlations between maternal levels of cortisol during pregnancy and fetal or newborn cortisol levels also provide support for the role of maternal glucocorticoid levels as a "programming" mechanism (Field et al., 2004; Gitau, Cameron, Fisk, & Glover, 1998). However, not all studies have found evidence for the relationship between maternal cortisol levels during pregnancy and infant temperament: Rothenberger, Resch, Dospod, and Moehler (2011) found that maternal perceived levels of stress were associated with infant affective reactivity to stressors, but cortisol levels during each trimester were not associated with infant outcomes.

The second proposed mechanism consists of enzyme deficits in the maternal placenta, which leads to increased fetal exposure to cortisol in *utero,* regardless of increases in maternal overall cortisol output during pregnancy. Glover, Bergman, Sarkar, and O'Connor (2009) have proposed that prenatal stress is associated with reduced activity of the enzyme 11-beta-hydroxysteroid dehydrogenase 2 (11b-HSD2), which metabolizes cortisol to its inactive form (cortisone) once it reaches the placenta, in order to regulate the transmission of glucocorticoids from mother to fetus. There is some evidence for their hypothesis; Glover et al. (2009) found that the correlation between maternal plasma cortisol levels and cortisol levels in the amniotic fluid is much greater for those mothers who report higher levels of trait anxiety during their pregnancies, suggesting increased passing of maternal cortisol through the placenta in the context of high levels of stress during pregnancy. Although there is no direct evidence for this proposed pathway among humans, two animal studies have shown that the 11b-HSD2 enzyme is downregulated in pregnant rats that undergo stress during pregnancy (Mairesse et al., 2007; Welberg, Thrivikraman, & Plotsky, 2005).

In summary, there is evidence that maternal HPA axis functioning during pregnancy exerts an important influence on offspring behavioral and physiological responses to stress during infancy and perhaps childhood, but studies have not followed subjects into middle childhood or adolescence, when many psychiatric symptoms become more prevalent. Animal studies provide convincing evidence for the causal role of glucocorticoids in offspring increased reactivity to stress during childhood and adulthood. Two mechanisms involving increased in *utero* exposure to cortisol have been proposed in the context of prenatal stress and offspring maladaptation. Importantly, early offspring dysregulated response to stressors may be a marker

for later internalizing or depressive problems (Essex, Klei, Cho, & Kalin, 2002; Smider et al., 2002); this association will be reviewed in the following section.

Child HPA Axis Dysregulation and Depressive Symptoms

Definition and Epidemiology of Childhood Depression

Depressive problems refer to a number of symptoms that accompany sad mood and can constitute a syndrome (dimensional approach) or be classified as a diagnosis (categorical approach). The *internalizing* or *anxious/depressed* cluster (Achenbach, 1991) includes symptoms such as "lonely," "cries a lot," "perfectionistic," "feels unloved," "nervous," "self-conscious," and "worries." On the other hand, Major Depressive Disorder (MDD), as defined in the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV-TR; American Psychological Association-APA, 2000), includes sad, depressed, or irritable mood, anhedonia (i.e., inability to experience pleasure) or diminished interest in most activities, poor appetite or overeating, diminished or excessive sleep, psychomotor agitation or retardation, feelings of worthlessness or excessive guilt, problems with concentration and decision making, and recurrent thoughts of death. A diagnosis of MDD requires experiencing at least five symptoms (including sad/irritable mood and/or anhedonia) nearly every day during a 2-week period.

Rates of MDD ranging from 2% to 6% among children and 4% to 16% for adolescents have been reported in large epidemiological studies (Birmaher, Ryan, et al., 1996). Moreover, many more children experience subsyndromal or moderate depressive symptoms, which are associated with increased risk for developing MDD during later childhood, adolescence and adulthood (Gotlib, Lewinsohn, & Seeley, 1995). Depression is relatively rare among young children and preschoolers (less than 1%), but becomes more frequent by school-age, with age of

onset typically around 11 years old (Kovacs, Feinberg, Crouse-Novak, Paulauskas, & Finkelstein, 1984). Developmental differences in symptoms have been reported: young depressed children are less likely to report feelings of sadness and hopelessness (Carlson & Kashani, 1988), hypersomnia, weight loss or gain, anhedonia, melancholic symptoms, and concentration problems (Kovacs, 1996; Sorensen, Nissen, Mors, & Thomsen, 2005; Weiss & Garber, 2003), as compared to adults. In contrast, children show more thoughts of worthlessness, somatic complaints, and psychomotor agitation (Sorensen, Nissen, Mors, & Thomsen, 2005; Ryan et al., 1987).

HPA Axis Dysregulation and Childhood Depression

HPA axis abnormalities have been proposed as a core mechanism of dysfunction for the development of depressive problems. As reviewed previously, the HPA axis is one of the main components of the body's response to environmental threats to the organism's state of homeostasis. Thus, dysregulation of this system may reflect increased sensitivity to stressors and depressive symptoms can emerge as alostatic load; that is, the associated cost of attempting to maintain homeostasis and associated chronic activation of the physiological stress response (McEwen, 2000). Goodyer (2008) has proposed that abnormal HPA axis functioning is associated with atypical early neurogenesis and acquired neuroendangerment. Abnormally high or low levels of cortisol are linked with dysregulation of the amygdala and associated ventral prefrontal areas, which are essential to threat signal detection. This may result in a greater and more rapid activation of emotion to incoming stimuli and intense negative reactions to potential stressors. In addition, adversity can result in cortisol hypersecretion, exposing the hippocampus to excessive cortisol, and evoking a decline in communication with associated structures (i.e., acquired neuroendangerment). Inefficient communication with the nucleus accumbens and

ventral tegmental area, which regulate pleasure and motivation, may be associated with the low positive emotionality that characterizes depressive problems (Caspi, Moffitt, Newman, & Silva, 1996).

Depressed adults display a well-established pattern of heightened HPA axis activity, reflected by abnormal basal and stress-challenged cortisol levels (Birmaher, Dahl, et al., 1996; Burke et al., 2005). Research examining HPA axis functioning among depressed children and adolescents also provides evidence for abnormal responses. In a recent meta-analysis, Lopez-Duran, Kovaks, and George (2009) found that depressed youth (ages 9 to 15) were characterized by an overactive response to stress and higher baseline cortisol levels. Evening basal cortisol levels have been found to be higher than those of non-depressed children and adolescents (ages 8 to 16; Goodyer et al., 1996), especially for those with co-morbid dysthymia (Herbert et al., 1996) and chronic depression (i.e., over a 1 year period; Goodyer, Park, & Herbert, 2001). In addition, Luby et al. (2003) provided evidence of outcome specificity, reporting higher cortisol secretion post-stressor among depressed preschoolers, as compared to children diagnosed with other psychiatric disorders. Importantly, studies with community (non-clinical) samples also suggest an early association between elevated cortisol levels and internalizing symptoms, suggesting that HPA axis hyperactivity is a precursor and not a consequence of depressive symptoms: high levels of afternoon resting cortisol predict high levels of mother-rated and teacher-rated internalizing symptoms among preschoolers (Essex et al., 2002; Smider et al., 2002). Supporting the role of elevated cortisol as a marker for later depressive problems, children at high-risk for depression due to familial predisposition also display a profile of HPA axis hyperactivity, characterized by high baseline levels of cortisol output (Ashman, Dawson, Panagiotides, Yamada, & Wilkinson, 2006; Young et al., 2006).

The pattern of HPA axis dysregulation that is associated with depressive symptoms in adults is not consistent across all studies with children and youth. For example, Birmaher, Dahl, et al. (1996) did not find differences in overall diurnal secretion levels among 6 to 13-year-old children, while DeBellis et al. (1996) found decreased cortisol secretion when measured during the first 4 hours after sleep onset. Hankin, Badanes, Abela, and Watamura (2010) have suggested that HPA axis response to stressors among depressed children and adolescents can vary as a function of their developmental stage: in their study, depressed toddlers had a blunted stress-induced cortisol response, while depressed teenagers showed an elevated peak, as compared to non-depressed peers. Importantly, results are also likely influenced by the existence of other co-morbid disorders or traumatic experiences. For example, DeBellis et al. (1996) included a large number of sexually abused children in their study (who potentially experienced PTSD symptoms), and these children had the lowest levels of cortisol. Finally, extant research has not examined the prolonged post-stressor cortisol response (i.e., slower return to baseline levels) characteristic of adults (Burke et al., 2005) among children, which can result in chronic brain exposure to cortisol and amplification of its negative impact on brain structures.

In summary, research provides evidence for HPA axis dysregulation among depressed children, non-depressed children with high levels of internalizing problems, and non-depressed children with familial predisposition for depression. The specific pattern of dysregulation is not consistent across all studies, although a recent meta-analysis suggests high cortisol baseline levels and overactive response to stressors (Lopez-Duran et al., 2009). Given the heterogeneity of clinical presentation among depressed children, characterizing all children within one generic profile of HPA axis dysregulation may not be accurate. Person-oriented methods (von Eye &

Bergman, 2003) can aid identification of more homogeneous profiles of neuroendocrine risk associated with depression and specific risk/protective influences.

Individual, Familial, and Environmental Risk and Protection for Depression

Risk and Protection: Maternal Mental Health, Early Parenting, SES, and Exposure to IPV during Childhood

The etiology and clinical manifestation of depression is heterogeneous. Multiple characteristics at the individual, family, and societal levels have been identified as risk factors for the development of depressive symptoms during childhood and a number of models that emphasize one or more of these domains have been proposed, including family models, life stress models, and biological models (Hammen & Rudolph, 2003). Most contemporary models propose contributions from different systems, including biological, psychological, and social levels, and the relative influence of each domain varies across individuals and across different stages of development (Cicchetti & Toth, 1998). In this section, the negative or protective impact of early maternal parenting, maternal mental health, low income, and intimate partner violence will be reviewed.

Maternal Mental Health and Early Parenting

Family models of depression have focused on the effects of early maternal parenting on the mother-child relationship and on children's development. Maternal mental health has been associated with internalizing symptoms among children of female victims of abuse or IPV (Kaslow et al., 2004; Morrel, Dubowitz, Kerr, & Black, 2003). Research consistently identifies a strong relationship between maternal depression and anxiety and offspring internalizing problems (Connell & Goodman, 2002), and having a parent with MDD is one of the strongest predictors for childhood depression (Beardslee, Versage, & Gladstone, 1998). Goodman and

Gotlib (1999) proposed four mechanisms of risk transmission, including (a) genetic, (b) offspring dysfunctional neuroregulatory mechanisms, (c) exposure to the mother's maladaptive affect, behavior, and cognitions, and (d) additional stressors associated with maternal mental health problems.

There is consistent evidence for the familial transmission of childhood depression, which will be discussed in the following section. In terms of neuroregulatory deficits, maternal depression and anxiety symptoms during pregnancy, infancy, and childhood are associated with abnormal HPA axis regulation among offspring, suggesting an impaired physiological response to stressors (Dougherty, Klein, Olino, Dyson, & Rose, 2009; Feldman et al., 2009). Maternal depression may also influence children's adaptation by providing a model of maladaptive coping strategies, negative emotionality and withdrawn behaviors. For example, Kliewer et al. (2004) found that, among children exposed to community violence, a mother's inability to regulate her sadness is a significant predictor of her child's internalizing problems. Lastly, maternal depression has a strong influence on maternal parenting, increasing negative maternal behaviors and disengagement, and decreasing positive parenting (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Importantly, both maternal depression and maternal behaviors are associated with childhood outcomes (NICHD Early Child Care research Network, 1999), providing evidence that maternal depression influences children's behaviors through multiple pathways.

The timing of maternal mental health problems influences the mechanisms through which it impacts children's adaptation. As described previously, mental health *during pregnancy* is most closely associated with neuroregulatory deficits, reflected by cortisol hypersecretion among children born to prenatally depressed and anxious mothers (Brennan et al., 2008; Grant et al., 2009; Gutteling et al., 2005; O'Connor et al., 2005). On the other hand, mothers who are only

depressed during the postnatal period are likely to shape their children's adaptation through modeling maladaptive affect regulation strategies and ineffective parenting.

Maternal parenting predicts childhood depressive symptoms (McLeod, Wiesz, & Wood, 2007). Specifically, low levels of parental warmth and high levels of parental aversive behavior are strongly related to children's depression. One mechanism of risk transmission is based on attachment theory. Bowlby (1982) proposed that infants who were unable to establish a secure attachment with a trusted caregiver would construct maladaptive "working models" or schemas of relationships, developing increased risk for depressive problems. Importantly, a meta-analysis demonstrated that maternal sensitivity during early childhood has a moderate effect on attachment (De Wolff & van IJzendoor, 1997), and numerous studies support the link between early attachment and later depressive symptoms (for a review, see Brumariu & Kerns, 2010).

Maternal involvement and warmth can also influence children's neuroendocrine functioning and sensitivity to stressors; Grant et al. (2009) found that depressed mothers with lower levels of sensitivity had infants with increased salivary cortisol levels in response to stressors, while Pendry and Adam (2007) reported abnormal diurnal cortisol rhythms among young children of mother's with low levels of warmth. These effects appear to be sustained in the long-term: Murray, Halligan, Goodyer, and Herbert (2010) reported that maternal levels of withdrawal during infancy were associated with higher cortisol secretion during adolescence.

In contrast, maternal warmth early in life can moderate the impact of early adversity (Fish et al., 2004) as it promotes the development of basic abilities necessary for later adaptation, including self-regulation (Jennings et al., 2008). Animal studies have consistently shown that early maternal behavior has a long-term stable influence on offspring's behavioral and endocrine response to stressors (Fish et al., 2004). Specifically, early maternal parenting can buffer the

impact of early adversity, including prenatal stress. Studies with rodents exposed to stressful manipulations in *utero* show that offspring endocrine and behavioral reactivity to stress can be decreased via early postnatal handling (Bogoch, Biala, Linial, & Weinstock, 2007; Wakshlak & Weinstock, 1990; Vallee et al., 1997) or high levels of maternal attention and stimulation after adoption (Maccari et al., 1995). Among humans, Kaplan, Evans and Monk (2008) found that observed high maternal sensitivity was associated with low levels of baseline salivary cortisol among infants of women with anxiety or depression problems during pregnancy, which were not different from cortisol levels of infants of healthy women, but were significantly lower than those of infants of anxious/depressed women with low sensitivity.

Intimate Partner Violence

The life stress model highlights the importance of cumulative adversity in the etiology of childhood depression, including poverty, family violence and high levels of stressful life events (Cicchetti & Toth, 1998; Luby, Belden, & Spitznagel, 2006; Sternberg et al., 1993). This perspective emphasizes the role of chronic stress as a vulnerability or trigger for depressive problems during childhood, particularly interpersonal stress and loss (Eley & Stevenson, 2000). In addition, this model also posits that individual stressors rarely occur in isolation, and environmental adversity impacts the family and individual systems (Sameroff, 2000).

Socioeconomic status (SES) has been widely recognized as a risk factor for psychiatric problems (Bradley & Corwyn, 2002; McLeod & Shanahan, 1996). Consistent with the life stress model, the stressors associated with lower SES, such as economic strain, family conflict or IPV, trauma, or discrimination, can influence the development of psychopathology (Wadsworth et al., 2008). In addition, children living in poverty have less social support and experience less adequate parenting (more authoritarian, less responsive; Evans, 2004). Parental mental illness

may also influence their ability to find and keep employment, resulting in family poverty; thus, poor children may be more likely to face genetic and environmental vulnerabilities (South & Krueger, 2011). Importantly, research shows that low SES is also associated with higher levels of salivary cortisol during childhood (Lupien, King, Meaney, & McEwen, 2001).

IPV may be particularly deleterious to women and their children, as it often occurs in the context of a pattern of chronic domination. Broad conceptualizations of IPV highlight the elements of isolation, threats and degradation, and coercive control (Walker, 1984), such that victims experience chronic fear, increased dependency on the abuser, and negative self-cognitions (Murphy & Hoover, 1999). For children, exposure to IPV may include unpredictable acute traumatic incidents in the context of chronic interparental conflict, resulting in constant fear and activation of the stress response. Consistent with the life stress model, IPV is associated with additional adversity, including more life stressors, difficult child temperament, maternal depression, and ineffective parenting (Eby, 2004; Graham-Bermann, Gruber, Girz, & Howell, 2009; Huang, Wang, & Warrener, 2010; Levendosky et al., 2006; Martinez-Torteya, Bogat, von Eye, & Levendosky, 2009). Notably, children exposed to chronic IPV are less likely to have additional individual and family strengths, such as positive temperament or maternal mental well being, and show a pattern of early maladaptation (Martinez-Torteya, Bogat, von Eye, & Levendosky, 2009)

Empirical evidence supports the link between IPV exposure and depressive problems among children (Perks & Jameson, 1999; Sternberg et al., 2006). Grych et al. (2000) explored different outcome patterns among children exposed to IPV. Their results showed a high-internalizing group, which was distinguished from a high-externalizing group by higher levels of male-to-female IPV, more aggression from parents, and higher perceptions of threat and self-

blame. Jouriles, Spiller, Stephens, McDonald, and Swank (2000) also reported that appraisals of threat were associated with child depression, but not with externalizing symptoms. These studies suggest that increased sensitivity to marital conflict is distinctively associated with internalizing symptoms; this pattern of hyper-sensitivity to conflict is consistent with the increased physiological reactivity to stressors found among children who witness IPV and those experiencing or at high-risk for depression (Luby et al., 2003; Saltzman et al., 2005).

Familial Risk and Gender as Moderators of Environmental Risk

Familial Risk

Biological models emphasize the role of genetic vulnerabilities and heritability. During childhood, depressive symptoms appear to have a high familial component, with 35% to 70% first-degree relatives and 10% to 25% second-degree relatives of depressed children reportedly diagnosed with a mood disorder (Kovacs, Devlin, Pollock, Richards, & Mukerji, 1997). Twin studies have addressed potential confounding factors, including the increased environmental adversity that offspring of depressed mothers experience, and have found moderate to high effects for genetic vulnerability (as compared to shared environmental or non-shared environmental influences; Eaves et al., 1997; Kendler, Gardner, & Lichtenstein, 2008). In terms of specific genetic markers, it has been demonstrated that the short allele of the serotonin transporter gene (5-HTTLPR) increases vulnerability for depression (Kaufman et al., 2006) through reduction in serotonin expression and uptake (Lesch et al., 1996). Current etiological models of childhood depression include interactions between genetic and environmental factors (Downey and Coyne, 1990; Eley et al., 2004; Rice, Harold, & Thapar, 2002). Specifically, children with genetic predisposition for depressive disorders are more likely to develop

symptoms as a response to environmental stress or adversity (Kaufman et al., 2006; Rice, Harold, Shelton, & Thapar, 2006).

Goodyer (2008) has proposed that the prenatal environment can have inhibiting or promoting effects on the genes that regulate the HPA system, modifying offspring reactivity to stress. In the context of prenatal stress, animal research suggests a significant interaction between genetic risk and exposure to stress in *utero*. For example, in a study with prenatally stressed rodents, the offspring only displayed an increased and prolonged glucocorticoid response to stressors during adulthood if they had a biological predisposition for high sensitivity to stress, but had a normal response to stressors when the genetic vulnerability was absent (Clinton, Miller, Watson, & Akil, 2008). Similarly, Lucassen et al. (2009) reported that only prenatally stressed rodents with biological predisposition to high stress sensitivity failed to increase placental levels of the 11BHSD2 enzyme (which transforms glucocorticoids to its inactive form in the placenta), resulting in increased fetal exposure to glucocorticoids. One recent study provides evidence that the relationship between prenatal stress and offspring temperament may be moderated by a genetic vulnerability among humans. Pluess et al. (2011) reported an association between maternal anxiety during pregnancy and offspring negative emotionality in early infancy only among infants carrying the 5-HTTLPR short allele, but no associations for those homozygous for the long allele. These studies suggest that prenatal stress may be a potential epigenetic process in the etiology of HPA axis dysregulation and depressive problems during childhood.

Gender

Research has consistently documented gender differences in the prevalence of depression during adolescence and adulthood (Costello, Egger, & Angold, 2005; Angold & Rutter, 1992)

but these differences do not appear to be present during childhood (Birmaher, Ryan, et al., 1996). However, gender may impact children's responses to specific risk factors. For example, Jacobvitz, Hazen, Curran and Hitchens (2004) reported that boys responded to a pattern of enmeshed parenting with increased ADHD symptoms, while girls with this family interaction style showed higher levels of depressive symptoms. In a similar study, Garai et al. (2009) found that girls' internalizing symptoms were predicted by maternal levels of depression and low parenting sensitivity, while these maternal characteristics were not associated with internalizing symptoms for boys. Importantly, Sternberg et al. (2006) reported gender differences in children's outcomes in the context of exposure to IPV. Girls exposed to family violence had higher levels of internalizing and externalizing symptoms, while IPV exposed boys were not significantly different from controls. The mechanisms that explain these gender differences are still unknown, but emotion regulation strategies have been proposed as a potential link; Silk, Shaw, Skuban, Oland, and Kovacs (2006) reported that daughters of depressed mothers used more passive emotion regulation strategies while boys were not different from controls, which may explain some of their higher risk for psychopathology in the context of adversity.

Gender differences may also play an important role in the "programming effect" of prenatal IPV. De Bruijn, van Bakel, Wijnen, Pop, and van Baar (2009) examined stress-induced responses after a mother-child interaction and a frustration task among toddlers and preschoolers. Maternal emotional complaints during pregnancy were associated with HPA axis reactivity among females only: Girls exposed to prenatal stress had higher stress-induced cortisol levels than non-exposed girls, while there were no differences between exposed and non-exposed boys. Notably, Van den Bergh et al. (2008) tested a mediation model for the effect of prenatal maternal anxiety on adolescent depressive symptoms, as mediated via baseline cortisol levels, and found

that this model predicted depressive symptoms among girls only; stress in *utero* was associated with a flattened diurnal profile of cortisol output among boys also, but neither prenatal anxiety or cortisol levels were associated with depression for boys.

The Present Study

The present study proposes a model that integrates the early risk associated with exposure to IPV during the prenatal period with a number of well established factors that convey vulnerability for childhood depression (i.e., family history of internalizing problems, maternal mental health, maternal early parenting, exposure to IPV during childhood), including the child's physiological response to stressors as a mediating mechanism. This research is guided by the "fetal programming" theory, which posits that prenatal adversity results in structural and functional neural changes that are associated with offspring neurodevelopmental deficits (e.g., Maccari et al., 2003), suggesting that pregnancy is a "sensitive period" for later adaptation to environmental stress due to the rapid fetal brain development. Secondly, the unique impact of IPV is supported by complex trauma theory, which proposes that chronic traumatic stress results in a number of lasting neurobiological deficits for the victim and thus hinders the developing fetus when it occurs during pregnancy. In particular, IPV is associated with high levels of shame and guilt due to its interpersonal and chronic nature (Calvete et al., 2007; Street et al., 2005) and impacts maternal representations of the developing fetus, which translate into early attachment and caregiving deficits (Dayton et al., 2010; Huth-Bocks, Levendosky, Bogat, & von Eye, 2004). Finally, consistent with a developmental psychopathology framework, multiple influences at the child, family and societal levels are included in the proposed model, and identification of the specific mechanisms that can translate early risk into distinct psychological symptoms is sought.

Addressing the earliest manifestations of specific psychiatric risk can promote the development of the basic competencies that will enhance later adaptation.

The present study builds on previous research examining the effects of prenatal adversity. One prospective longitudinal study reported associations between increased stress in *utero* and depressive problems during adolescence, as mediated via HPA axis functioning (Van den Bergh et al., 2008); however, these authors did not examine the impact of specific types of stressors, including traumatic stress, despite evidence of distinct outcomes associated with different stressors (Wheaton, 1996). In contrast, studies that specifically examine the effects of exposure to IPV during pregnancy have found links with negative offspring health and psychological outcomes during the perinatal and infancy periods (e.g., Coker et al., 2004; Huth-Bocks et al., 2002; Levendosky et al., 2006; Martinez-Torteya, Field, et al., 2009; Quinlivan & Evans, 2005), but have relied solely on maternal reports, have not used a disorder-specific or mechanistic perspective, and have not examined long-term offspring outcomes following exposure to IPV in *utero*.

This research addresses some of the limitations of the extant literature. First, its prospective longitudinal nature allows examination of the influence of risk and protection at different developmental periods on children's depressive problems. Second, results are based on different reporters (mother and child) and different methods of assessment (biological samples, questionnaires, semi-structured interview, and coded laboratory observations). In addition, the current research includes both variable- and person-oriented approaches to hypothesis testing to address the conflicting findings reported by previous research; aggregating all subjects in a single group may misrepresent relationships between variables in significant ways, while identification of homogeneous profiles of HPA axis dysregulation or subgroups of children with

specific individual or familial risk may help clarify specific within-group patterns of association (von Eye & Bergman, 2003).

In addition, most studies to date with prenatally stressed samples have failed to propose etiological pathways that are specific to one psychiatric outcome and have instead focused on general associations between stress during pregnancy and maladaptation (e.g., O'Connor et al., 2002). Unfortunately, this perspective provides little information for targeted intervention and prevention efforts. In contrast, the present research uses a disorder-specific perspective, based on findings of increased difficult temperament, inhibition, high levels of negative affect, high levels of internalizing symptoms, and HPA axis dysregulation among prenatally stressed children, which are consistent with behavioral and neuroendocrine precursors to depressive symptoms.

The current study examined the contribution of exposure to IPV in *utero* to the development of depressive symptoms during childhood, as reported by both the child and the mother, as well as mediation via children's cortisol levels in response to a laboratory stress-induction task. Mediation is proposed, although interpretation of causality is limited, as cortisol levels were assessed concurrently with depressive symptoms, rather than during a prior assessment. However, previous studies document that HPA axis dysregulation is a precursor of depressive symptoms (Essex et al., 2002; Smider et al., 2002), and no studies to date have documented the opposite relationship among children (HPA abnormalities that developed as a consequence of depression). To assess for individual differences in stress reactivity, the relationships between empirically derived profiles of stress-induced responses and depressive symptoms will be examined in the present research. The influence of other individual and environmental risk experienced during the prenatal and postnatal periods was also examined,

including prenatal maternal mental health, current maternal mental health, IPV exposure, income, and maternal early parenting. Based on previous research, familial risk and gender will be explored as moderators, as they may enhance or buffer the impact of other adversity.

Hypotheses

1. Prenatal exposure to IPV predicts HPA axis dysregulation (as indexed by salivary cortisol levels) after controlling for familial (family history of depression) prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income). Analyses using both variable- and person-oriented approaches will be pursued to test this hypothesis.
2. Prenatal exposure to IPV predicts childhood depressive symptoms after controlling for familial (family history of depression) prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income).
3. HPA axis dysregulation (as indexed by salivary cortisol levels) is associated with higher levels of depressive symptoms, after controlling for familial (family history of depression) prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income).
4. The effect of prenatal IPV on childhood depressive symptoms is partially mediated through a dysregulated HPA axis stress response (as indexed by salivary cortisol levels).
5. The effect of prenatal IPV is moderated by gender and family history of depression. It is predicted that girls will be more susceptible to the impact of prenatal stress than boys. In addition, those with genetic predisposition (as indexed by family history of depression)

will also be more susceptible to the impact of prenatal stress. Analyses using both variable- and person-oriented approaches will be pursued to test this hypothesis.

Methods

Participants

Participants were a subset of mother-child dyads recruited through a larger longitudinal domestic violence study (www.msu.edu/~mis), who completed up to 9 waves of data collection and were assessed for the 10th time, around children's age 10. Participants of the larger longitudinal study were 206 pregnant women recruited throughout the Clinton, Eaton, Ingham, and Shiawassee counties of Michigan, through fliers posted at Obstetric/Gynecologic or women's health clinics (39%), libraries, laundromats, stores, and similar public places (27%), social service programs such as FIA, WIC, Head Start, Jump Start, and Maternal Infant Outreach Program (26%), childbirth classes (5%), the county prosecutor's office (2%), and a local domestic violence shelter (1%). Inclusion criteria for the longitudinal study was: 1) being in the last trimester of pregnancy at the time of the initial interview, 2) 18 to 40 years of age, 3) involvement in a romantic relationship for at least 6 weeks during the pregnancy, and 4) understanding English well enough to complete questionnaires and interviews. The average age of women was 25 years (*SD* = 5). Forty-five percent of the women had a high school diploma or some high school education; 35% had some college education; 15% had an Associate or Bachelor's Degree, and 5% had a graduate degree. The mean monthly family income was $1,823 (*SD* = $1,507), ranging from $0 to $9,500. Half of the women were single, never married, 40% were married, and 10% were separated, divorced, or widowed. Children were 51% boys and 49% girls. Forty-six percent of the children were identified by their mothers as

White/Caucasian, 24% Black/African American, 23% Multiracial, 2% Latino, 2% Native American, and 1% Asian American.

The final sample for the present study consisted of 119 mother-child dyads (65 boys and 54 girls). Ethnicity was 50% white, 23% Black/African-American, 23% multiracial, 2% Latino, 1% Native American and 1% Asian American. The mean monthly family income was $2,002 (*SD* = $1,652). Eleven percent of the women did not complete High School, 28% completed HS, 42% completed some college or trade school, 11% had a BA/BS, and 6% had some graduate school or a graduate degree. Those who were not included in the present study had similar demographics to those who completed this wave of data collection; however, those who did not participate in the current study had significantly lower monthly family income during pregnancy (See Table 1).

Measures

Prenatal levels of IPV (maternal report), maternal depression, and maternal anxiety were collected during the first wave of data collection (*M* = 33 weeks gestation) using the same questionnaires that were used in the present assessment. Exposure to IPV was measured via maternal report during interviews around child's age 1, 2, 3, 4, 5, 6, and 7. Maternal parenting was assessed via observational and self-report measures around ages 1, 2, and 3. Family history of depression was assessed around the child's 3rd birthday. All other measures included in this study were collected during the present (age 10) assessment (See Table 2).

Dependent Variables: Maternal Report

Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL; Kaufman, Birmaher, Brent, Rao, & Ryan, 1996). Parent report of Major Depressive Disorder was used to assess children's current and past depressive symptoms.

This semi-structured clinical interview is based on DSM-IV criteria and provides reliable and valid psychiatric diagnoses for children 6 to 18 years old. Percent agreement for all diagnoses ranges from 93% to 100%, test-retest reliability ranges from .63 to .90, and diagnostic categories are consistent with scores in the Child Behavioral Checklist (CBCL) subscales (Kaufman et al., 1997). In the present sample, 8% of children met lifetime diagnostic criteria for MDD, while 6% had a lifetime subthreshold diagnosis. Current symptoms are rated as not present (0), subthreshold (1), and present (2). Scores for all depression items were summed into a current symptoms score. Mean score for current symptoms (range = 0 to 20) was 1.34 (*SD* = 1.86).

Child Behavioral Checklist for ages 6-18 (CBCL/6-18; Achenbach & Rescorla, 2001). This 113-item questionnaire assesses maternal report of behavioral and emotional problems, yielding 2 broadband internalizing and externalizing scales and 8 empirically derived subscales. This checklist has good reliability; internal consistency ranges from $\alpha = .72$ to $\alpha = .94$ and test-retest reliability ranges from $r = .82$ to $r = .92$. Validity is supported through correlations with the Behavior Assessment System for Children (BASC) Scales ($r = .38$ to $r = .88$) and a high percentage of correct classification of referred vs. non-referred children (80% to 85%; Achenbach & Reschorla, 2001). The age-normed T-score (range = 30 to 100) for the Depressed/Withdrawn scale was used to assess child depressive symptoms; higher scores indicate higher levels of depression as compared to other children of the same age. For the present sample, $\alpha = .82$, $M = 53.11$, $SD = 6.61$. Thirteen percent of children had depression levels above the borderline cut-off score (T-score >= 60).

Dependent Variables: Child Report

Children's Depression Inventory (CDI; Kovacs, 1992). This 27-item questionnaire assesses depressive symptoms among 6 to 17 year-old children, yielding 5 subscales: Negative

Mood, Interpersonal Difficulties, Negative Self-Esteem, Ineffectiveness, and Anhedonia. Children are asked to select one out of three statements that best describes their feelings during the past two weeks. This is a reliable and well-validated measure; internal consistency coefficients range from α = .71 to α = .89, test-retest coefficients range from *r* = .74 to *r* = .83, and discrimination of depression vs. other psychiatric problems is adequate (Kovacs, 1992). The Total age-normed T-score (range = 0 to 54) was used; higher scores reflect higher levels of depression. For the current sample α = .83, *M* = 44.90, *SD* = 7.68. Six percent of children had depression levels above the borderline cut-off score (T-score >= 60).

Behavioral Assessment System for Children- Self-report of personality (Reynolds & Kamphaus, 2002). This 131-item self-report measure assesses behavioral and emotional problems among 8 to 11 year-old children. The 13-item depression subscale was used to evaluate children's depressive symptoms. Children are asked to rate items as "true" or "false" or in a 4-point frequency scale. The depression score (range = 0 to 20) was used; higher scores reflect higher levels of depression. Good reliability and validity have been reported (Reynolds & Kamphaus, 2002). For the current sample, depression subscale α = .71, *M* = 3.38, *SD* = 2.78.

Independent Variables: Maternal Report

Severity of Violence against Women Scales (SVAWS; Marshall, 1992). This 46-item questionnaire assesses violent behaviors and threats that the woman has experienced from her partner during the past year. Examples of items include "Destroyed something belonging to you," and "Punched you." Women rate their experiences on a 4-point frequency scale. High internal consistency (α = .97) has been reported for the full scale (Huth-Bocks, Levendosky, & Semel, 2001). For the present study, ratings for items 9 to 46 were added to create a battering score (range = 0 to 114); higher scores represent more frequent abuse. Violence during

pregnancy was measured during the mother's 3rd trimester (*M* = 33 weeks gestation). For the present sample, α = .93, *M* = 2.8, *SD* = 6.94. Thirty-one percent of women experienced IPV during pregnancy. An IPV score was obtained for each time period and α ranged from .91 to 1.0. Correlations between different time periods ranged from .03 to .67, and the average for all correlations was .35. To account for total exposure to IPV throughout childhood, a lifetime exposure to IPV variable was created by summing the scores at ages 1, 2, 3, 4, 5, 6, 7, and 10. In the present sample, lifetime IPV *M* = 17.45, *SD* = 35.63, and 61% of children were exposed to IPV by age 10.

Maternal Mental Health. Scores for the *Beck Depression Inventory (BDI; Beck, Mendelson, Mock, & Erbaugh, 1961)* and the *Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983)* were combined to obtain an index of maternal mental health. The BDI is a 21-item self-report questionnaire measuring symptoms of depression. Women select the best evaluative statement out of 4 options, which describe their feelings and behaviors during the last two weeks, with values from 0 to 3 (e.g., "I have no appetite at all anymore" = 3). Good internal consistency has been reported (α = .86; Beck, Steer, & Garbin, 1988). The total score (range = 0 to 63) was be used; higher scores reflect more severe symptoms. For this sample, α = .86, *M* = 10.10, *SD* = 6.91 during pregnancy. During the present assessment, α = .89, *M* = 2.68, *SD* = 3.84. The 6-item BSI anxiety scale measures symptoms of anxiety. Participants rated how much each symptom affected them during the past two weeks using a 5-point scale, ranging from "Not at all" to "Extremely." Examples of items include "Feeling easily annoyed or irritated," "Feeling fearful," and "Feeling that you are watched or talked about by others." Derogatis and Melisaratos (1983) report good internal consistency (α = .81) and adequate test-retest reliability (*r* = .79). The total score (range = 0 to 24) was used; higher scores indicate more severe anxiety.

For this sample, α = .83, *M* = 4.52, *SD* = 4.38 during pregnancy. During the present wave of data collection, α = .85, *M* = 5.98, *SD* = 6.56. Correlations between concurrent maternal depression and anxiety were strong (r = .70 and .57), supporting an aggregate score to avoid multicollinearity. For the maternal mental health composite, *M* = 14.53, *SD* = 10.45 during pregnancy and *M* = 8.66, *SD* = 9.31 during the present assessment.

Maternal Early Parenting. Parenting was measured via maternal self-report and laboratory observation. The 20-item Nurturing scale from the Parent Behavior Checklist (PBC; Fox, 1994) was completed by mothers when their children were 1, 2, and 3 years old. Items are scored on a 4-point scale (e.g., "I read to my child at bedtime,") and higher total scores (range = 20 to 80) reflect more nurturing parenting. High internal consistency has been reported for the nurturing scale (α = .82; Fox, 1994). Scores ranged from 31 to 75 (Age 1 *M* = 56.98, *SD* = 8.56; Age 2 *M* = 62.08, *SD* = 9.42; Age 3 *M* = 62.49, *SD* = 9.51). In addition, a mother-infant interaction (MII) also assessed maternal parenting at age 1. Mother and infant were videotaped in a 30-minute free-play situation. Following Ainsworth, Bell, and Stayton (1971) maternal sensitivity was coded from 1 to 5. Higher sensitivity scores suggest that the mother perceives and accurately interprets the infant's signals and responds to them appropriately and promptly. Scores ranged from 1 to 5 for Sensitivity (*M* = 2.86, *SD* = 1.10). Correlations between all parenting indices were moderate to strong (r = .29 to *r* = .66).

Family History (Klump, 2001– unpublished). Near the child's third birthday, mothers were asked to indicate whether any family members (including the mother herself) have had major psychological problems with depression, and if so, which family members (e.g., sister, cousin, in relation to *mother*). A sheet with the definitions of the disorder was presented to the woman in case she had any questions about the diagnostic terms. The mother also completed the

form for the child's *father*, to the extent that she knew the history. The measure is scored positive or negative for history of that particular illness. A dichotomous measure was used; children with family history of depression on either the maternal or paternal side will receive a positive score. Forty-three percent of children had a positive family history of depression.

Income. Mothers reported on their average monthly family income throughout the last year. Last year's income was used in all analysis, rather than income during pregnancy, given evidence that recent SES has more influence on internalizing symptoms during childhood than does early income (Ackerman, Brown, & Izard, 2004).

Independent Variables: Child Report

Conflict Tactics Scale—Child Report (CTS; Straus, 1979). The modified 19-item verbal/symbolic and physical aggression scales from the Conflict Tactics Scale—Form N measure children's report of the frequency with which their mother and her male partner use aggression to resolve conflict, using a 4-point scale, ranging from 0 *(never)* to 6 *(more than 20 times during the past year).* Item examples include "Father insulted or swore at mother" and "Father pushed or shoved mother." Internal consistency for this adapted measure is high (α = .87; O'Brien, Bahadur, Gee, Balto, & Erber, 1997). The total score for male-to-female aggression (range = 0 to 76) will be used; higher scores indicate higher levels of IPV. For the present sample, α = .80, M = 4.95, SD = 6.71. Sixty-four percent of the children reported witnessing some verbal and physical aggression towards their mother during the past year.

Experimental Manipulation

Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum et al., 1997). After a brief period of non-stressful interactions, the experimenter told the child that he/she had to create a very exciting 5-minute ending for a story and his/her response would be videotaped and

reviewed by a judge. The story read was: "Yesterday my best friend Robert and I went home from school. Suddenly, we had the idea to visit Mr. Greg who lived in the big old house located in the dark forest near our town. Mr. Greg was a crazy old man and our parents didn't like the idea that we sometimes went visiting him. There was a rumor in town that there was a mystery about the old house. When we arrived at the house we were surprised that the door was open. Suddenly we heard a strange noise and cautiously, we entered the dark hall. . ." After a 5-minute preparation period, a second experimenter, unknown to the child, entered the room and asked the child to stand by the camera and finish the story, so that his/her performance could be video recorded and reviewed by the "judge." The experimenter maintained a serious stance while listening to the child's story, and if the child finished the story in less than 5 minutes, the experimenter asked the child to elaborate on his/her story.

Mathematical Calculation Task (Buske-Kirschbaum et al., 1997). Children were asked to serially subtract the number 7 from 758 as fast and as accurately as possible, and were told their performance would be compared to other children's. On every failure, the experimenter said "Stop, please start again" and the child had to restart at 758. After four mistakes the task was discontinued.

Children completed a 5-point manipulation check of how stressful they found the speech and arithmetic tasks. These combined tasks are adapted from a standardized adult stress paradigm and have been reported to elicit a reliable physiological stress response among children 9 to 14 years of age (Buske-Kirschbaum et al., 1997). In the present sample, children found this task to be somewhat stressful ($M = 3.24$), with 37% of children giving a rating of "quite stressful" or higher and only 5% of children providing a rating of "not stressful at all." Children were debriefed and received a certificate for their participation.

Salivary Cortisol Collection

Saliva samples were obtained using the passive drool method before the stressful task, as well as 20 and 40 minutes after the stress manipulation. Children were asked to gently pass saliva into a 2 mL tube using a straw, following the procedures outlined by Salimetrics, LLC and recommendations of Douglas Granger, PhD. (2009, personal communication). Children imagined eating their favorite food and were offered a citric scent to stimulate saliva production. Immediately after collection, saliva was placed in a cooler, and samples were stored at -70°C after the interview was completed. Samples were shipped to Salimetrics, LLC following best practice guidelines and assayed in duplicate for salivary cortisol levels. Scores for each time period were *M* = .088 ug/dl for baseline, *M* = .076 ug/dl for peak and *M* = .053 ug/dl for recovery. Four different scores were calculated as indices of HPA axis activity, following the recommendations of Fekedulegn et al. (2007): (1) area under the curve with respect to ground (*AuCg*; total area under all measurements), (2) area under the curve with respect to increase (*AuCi*; area under measurements with reference to baseline levels), (3) cortisol increase (peak – baseline), and (4) cortisol decrease (peak – recovery).

The *AuC* indexes were calculated using the formula from Pruessner, Kirschbaumb, Meinlschmide, and Hellhammer (2003), as follows:

AuCg = [(baseline + peak)/2 * (time between sample 1 and 2 = 40 min)] + [(peak + recovery)/2) * (time between sample 2 and 3 = 20 min)]

AuCi = [(baseline + peak)/2 * (time between sample 1 and 2 = 40 min)] + [(peak + recovery)/2) *(time between sample 2 and 3 = 20 min)] – [baseline * (time between sample 1 and 3 = 60 min)]

Procedures

For the larger longitudinal study, pregnant women contacted the research office if they were interested in participating in the study, at which time a research assistant conducted a brief screening to determine eligibility and provided a description of the assessment protocol. To oversample for women who experienced domestic violence during pregnancy, items 9-19 from the Conflict Tactics Scale (Straus, 1979) began to be administered over the telephone after approximately half the sample had been recruited and interviewed (n = 96). Overall, 161 women who were screened were ineligible because they did not meet age, relationship status, or battering experience criteria. However, there were no other demographic differences between excluded women and participants.

Eight undergraduate and five graduate research assistants conducted the pregnancy assessment. They were trained to administer the questionnaires and conducted two to five supervised interviews until they reached 95% reliability for standard administration of measures. The interviews lasted about 3 hours and were conducted in the woman's home or the project office. Interviewers were blind to the women's battering status, administering the violence questionnaires last.

During the data collection when children were age 7, mothers were asked if they would like to be contacted for future assessments and indicated if they wished to be contacted directly or though an "alternative contact." For the present wave of data collection, participants who consented future contact were approached. If they asked to be contacted directly, participants were telephoned according to any preferences indicated (e.g., blocking caller ID). A research assistant invited the woman to participate in an interview with her child, providing a brief description of the present study. If the woman was interested in participating, she was scheduled

to come in for an interview to the project's office. A number of options for future contact were offered to ensure the woman's safety, including blocking caller ID, not leaving messages on the answering machine, not leaving messages if someone other than the participant picked up the phone, and not identifying ourselves as the MSU Mother-Infant Study. If unable to contact the woman over the phone, and if the woman had agreed, a letter inviting the woman to call the project office was sent to her home address.

When staff was unable to contact the woman directly the friend/relative recontact information provided by the woman during her last interview was used. During the 7 year old assessment, women provided the address and telephone numbers of up to 3 friends or family members, and signed letters that were sent to these "recontact" individuals, explaining that the woman participated in the Mother-Infant Study and had given permission for the research staff to communicate with them if the staff was unable to locate the participant. When telephoning the re-contact individuals, research assistants left a message to be passed along to the participant. If we were unable to reach the "recontact" individuals by telephone, a letter was sent to their address.

For the present wave of data collection, the mother and her 10-year-old child came to MSU for the assessment. Because levels of salivary cortisol naturally rise and decrease with the circadian rhythm, all interviews were started between 4 and 5 pm to restrict the potential impact of time of saliva collection. Upon arrival, mother and child completed the informed consent and informed assent procedures, and then completed the rest of the assessment in separate rooms. The mother completed questionnaires and interviews with a Master's level clinician (Interviewer), while the child completed questionnaires and a challenging task in a separate room with an advanced undergraduate research assistant (Child Tester). Child outcomes were assessed

using both maternal and child report, in order to increase the external validity of the information gathered, and consistent with the children's cognitive capacities.

The challenge task was selected to test children's increased/decreased sensitivity to mild stressors. Salivary cortisol was used as a measure of HPA axis because it is a minimally invasive procedure and salivary cortisol levels are highly correlated with blood serum cortisol levels (Schwartz, Granger, Susman, Gunnar, & Laird, 1998). Saliva was collected during resting condition upon arrival to the interview, 20 minutes after the challenging task (to capture peak levels), and 40 minutes after the challenging task (to capture return to baseline/resting levels). After the challenging task (before the second and third saliva collections), children spent 20 minutes engaged in age-apropriate free play, aimed at facilitating return to a positive mood and baseline levels of stress.

If the mother or the child indicated suicidal ideation during the interview, a suicide protocol was completed by the master's level clinician to assess the degree of risk. None of the participants assessed were actively suicidal, and clinicians provided referrals for mental health services to all families. At the end of the interview, women provided recontact information for potential future assessments, received a list of resources of support and counseling services, and received financial compensation for their participation.

Nineteen participants were unable to come to the project office for the assessment because they lived out of state. These women completed all mother-report questionnaires over the telephone with a Master's level clinician. Child's report of depressive symptoms and IPV, as well as saliva samples, were not obtained from these families.

Saliva Samples Storage and Analysis

At the end of the interview, saliva samples were stored in a locked laboratory freezer at -70 F. Upon completion of data collection, all samples were sent to Salimetrics, LLC for assaying in duplicate. The assay (25 ul test volume) is 510K cleared (US FDA) as a diagnostic measure of adrenal function: range of detection is from 0.003 to 3.0 µg/dl, inter and intra-assay coefficients of variation are less than 10 and 15%. The correlation between plasma and saliva cortisol levels is 0.91. The assay is highly specific to cortisol, with less than 0.5% cross-reactivity for other steroids. Saliva samples were destroyed 30 days after assays were completed.

Data Storage

To protect confidentiality to the highest extent possible, participant code numbers, not participant names, were placed on the questionnaires and videotapes. All data, including videotapes, were stored in locked file cabinets. The information linking ID's with participant names (i.e., consent form, participation voucher, contact information sheet) was separated from the rest of the data and placed in a separate file.

Training

The author was previously trained to administer and code the semi-structured interview (K-SADS-PL) and to assess victims of domestic violence. Six undergraduate research assistants were trained as child testers, observing the first author administering questionnaires and collecting saliva samples, and being evaluated while administering the protocol, to assess reliability of administration. In addition, six additional Master's level clinicians were trained to administer and code the semi-structured interview and questionnaires with the mother, as well as the challenging task with the children. All undergraduate research assistants were trained as data

enterers and schedulers, using the procedures developed to protect women's safety and confidentiality. All interviewers and child testers were trained to be sensitive to the special challenges that working with this population involves.

Results

Missing Data

Missing data were imputed using the Expectation-Maximization algorithm of SPSS 17.0 (SPSS: An IBM Company, 2010). Overall, only 7% of all data points were imputed. To identify any possible differences between participants with missing data and the rest of the sample, the pattern of missingness was examined. Participants were categorized into those with missing data and those with complete data; t-test comparisons for all variables were estimated. Results showed non-significant differences on all variables used for analysis. In addition, the MCAR statistic indicates that data was missing at random (χ^2 = 816.20, *df* = 1008, *p* = .98)

Descriptive Statistics

Overall, variables showed the expected associations. Maternal mental health during pregnancy had a large correlation with current mental health (*r* = .39). Similarly, pregnancy IPV had a large correlation with lifetime exposure to IPV (*r* = .42). In terms of cross-informant correlations, maternal ratings of lifetime IPV had a large correlation with child's report of current IPV (*r* = .39). For depression indices, maternal ratings on the structured interview were highly associated with mother-reported Withdrawn/Depressed scores on the CBCL (*r* = .50). Similarly, child reported levels of depression were highly correlated using both questionnaires (CDI and BASC, *r* = .63). However, KSAD-MDD current symptoms were not associated with child's report of depressive symptoms, while maternal responses to the CBCL had small to medium associations with child's report (CDI *r* = .25; BASC *r* = .19). Pregnancy risk (IPV and

maternal mental health) showed small to medium associations with depression scores (r = .21 to .29), while postnatal risk (lifetime IPV, current IPV, current maternal mental health, and income) had small to large associations with outcomes (r = .21 to .39). Lower income was associated with higher levels of pregnancy and lifetime risk (r = -.25 to -.32), as well as higher child-reported depression (r = -.19 to -.23). Family history of depression was correlated with maternal current mental health (r = .30) and maternal reports of child depression (r = .20 to .27). In addition, measures of HPA axis functioning were highly associated among themselves (r = .44 to .80) and were associated with maternal reports of child depression (r = .22 to .30; See Table 3).

Data Analytic Plan

Statistical analyses were completed using Mplus 4.2 (Muthen & Muthen, 2007) and SPSS 17.0 (SPSS: An IBM Company, 2010). For all structural equation models (SEM), global fit was evaluated using the overall χ^2 test of model fit ($p > .05$), the root mean square error of approximation (RMSEA < .08; Browne & Cudeck, 1993), the comparative fit index (CFI > .95), and the standardized root mean square residual (SRMR < .07). Additional absolute model fit indices are also reported for comparisons between models, including the Akaike's information criterion (AIC) and the Bayesian information criterion (BIC). Lower values for the AIC and BIC indicate improved fit.

Hypothesis Testing

Hypothesis 1

Prenatal exposure to IPV was expected to predict HPA axis dysregulation (as indexed by salivary cortisol levels) after controlling for familial (family history of depression) prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income). Models predicting each of the cortisol outcomes

were estimated, using pregnancy exposure to IPV, pregnancy maternal mental health, lifetime exposure to IPV, child report of current IPV, current maternal mental health, family history of depression, and child's gender as manifest variables predicting outcomes. An early maternal sensitivity latent variable was estimated using observed maternal sensitivity at age 1, as well as maternal report of nurturance at ages 1, 2, and 3 (See Figure 1). Due to the lack of association between cortisol levels and income, models were estimated with and without income as a predictor; since results remained mostly unchanged, results are reported for the most parsimonious model (i.e., model without income).

The first model explained 5% of the variance of *increase* in cortisol levels and was a good fit for the data, χ^2= 29.99, *df* = 26, *p* = .27; CFI = .98, RMSEA = .04, SRMR = .04. Child report of current IPV predicted higher increase from baseline to peak, *standardized b* = .21, *p* = .03. The second model predicted *decrease* in cortisol levels using the same familial, prenatal, and postnatal risk. This model explained 11% of the variance in decrease and was an excellent fit for the data, χ^2 = 24.76, *df* = 26, *p* = .53; CFI = 1.00, RMSEA = .00, SRMR = .04; IPV during pregnancy, *standardized b* = .26, *p* = .01, and current levels of IPV (child report), *standardized b* = .27, *p* = .00, predicted a larger decrease from peak to recovery. The third model (using the same predictors) explained 5% of the variance of *AuCg* and it was an excellent fit for the data, χ^2 = 22.92, *df* = 26, *p* = .64; CFI = 1.00, RMSEA = .00, SRMR = .03. IPV during pregnancy predicted cortisol levels respective to ground, *standardized b* = .21, *p* = .05. Finally, the fourth model (using the same predictors) explained 4% of the variance of *AuCi* and provided a good fit for the data, χ^2 = 28.61, *df* = 26, *p* = .33; CFI = .99, RMSEA = .03, SRMR = .04. However, none of the predictors were significantly associated with cortisol levels respective to increase.

Overall, exposure to IPV during pregnancy and child report of current IPV were associated with cortisol levels (*AuCg*, increase, and decrease).

Mean cortisol levels at baseline, peak, and recovery did not follow the expected inverted-U shape within the present sample. However, aggregating all subjects in a single group can misrepresent the individuals within the group in many important aspects (von Eye & Bergman, 2003). Alternatively, a person-oriented approach assumes that individuals are unique and relatively homogeneous subgroups can be identified based on predictable patterns that occur across the dependent and independent variables (Bogat, Levendosky, & von Eye, 2005). For example, Cicchetti, Rogosch, Gunnar, and Toth (2010) reported that depressed children displayed a flattened pattern of daily cortisol output only when also exposed to early trauma, while depressed non-traumatized and controls displayed different profiles. Latent Profile Analysis (McCutcheon, 1987) was conducted using baseline, peak, and recovery cortisol scores to identify subgroups of children with distinct profiles of stress-induced cortisol output. Model fit was evaluated using log-likelihood, BIC, AIC, and entropy, as suggested by Grant et al. (2009). Lower log-likelihood, BIC and AIC suggest increased external validity or generalizability, while higher entropy reflects maximal distinction between the groups (Kline, 2005).

Models with one through four latent profiles were estimated. Fit indices (See Table 4) suggest that AIC and BIC improve as the number of profiles increase, with a significant improvement on both indices from the 1-profile model to the 2-profile model, and from the 2-profile model to the 3-profile model. AIC and BIC difference was moderate between the 3-profile model and the 4-profile model. In addition, entropy is best for the model with 3 profiles; thus, this model was chosen as the best fitting one. Means for the 3 latent profiles suggested a

group (n = 88) with consistently low levels of cortisol at baseline, peak and recovery (See Figure 2). The second profile was comprised of a small group of children (n = 10) who displayed consistently high levels of cortisol, with an increase from baseline to peak, and a large decrease from peak to recovery. Children in the third profile displayed a decreasing trajectory of cortisol levels, with overall medium levels of cortisol (n = 21).

Multinomial logistic regression (Hosmer & Lemeshow, 1989) was utilized to predict profile membership (high, medium, or low cortisol). Pregnancy exposure to IPV, pregnancy maternal mental health, lifetime exposure to IPV, child report of current IPV, current maternal mental health, early maternal sensitivity, family history of depression, and gender were entered as predictors in this model. The factor score for early maternal sensitivity estimated in the previous models was saved and used as a manifest variable in the regression models. All predictors were entered into the first step of the model. Because high levels of cortisol have been consistently linked with risk for internalizing problems, the high cortisol class was used as the reference group.

The proposed model showed significantly better fit than the null model, LR-χ^2 (16, N = 119) = 33.12, p = .01, and the overall model fit was good, LR-χ^2 (220, N = 119) = 194.88, p = .89; Pearson χ^2 (220, N = 119) = 142.38, p = 1.00. Taken together, all predictors explained a medium amount of variance in group membership (Nagelkerke r^2 = .32). Pregnancy IPV, LR-χ^2 (2, N = 119) = 11.23, p = .00, child's report of current IPV, LR-χ^2 (2, N = 119) = 14.85, p = .00, and early maternal sensitivity, LR-χ^2 (2, N = 119) = 8.90, p = .01, emerged as significant predictors (See Table 5). Predictors had small effect sizes. Children with higher levels of

pregnancy IPV were more likely to be in the high cortisol group, as compared to the low cortisol group (1.20 times; OR = .84, $CI_{.95}$ = .73, .96) and the medium cortisol group (OR = 1.35 times, OR = .74, $CI_{.95}$ = .58, .85). Children who reported higher levels of current IPV were also more likely to be in the high cortisol group as compared to the medium (1.36 times; OR = .73, $CI_{.95}$ = .61, .89) and low cortisol groups (1.16 times; OR = .86, $CI_{.95}$ = .77, .96). Interestingly, more early maternal sensitivity predicted membership in the high cortisol group (1.35 times; OR = .74, $CI_{.95}$ = .59, .93), as compared to the medium cortisol group. Multinomial regression also supports the association between exposure to IPV during pregnancy and current IPV exposure with a profile of neuroendocrine risk.

Hypothesis 2

Prenatal exposure to IPV was expected to childhood depressive symptoms after controlling for familial (family history of depression), prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income). Discrepancies between child and mother reports on child's behavior have been consistently reported, especially for internalizing symptoms (De los Reyes & Kazdin, 2005). Epidemiological studies have shown that child self-report yields higher levels of depressive symptoms as compared to maternal reports (Braaten et al., 2001). In contrast, depressed mothers tend to report more internalizing symptoms for their children, as compared to the children's self-reports (van der Toorn et al., 2010). Since both informants convey important information about the child's emotional outcomes, the impact of prenatal IPV was evaluated estimating two child depression latent variables, one as reported by mother and the other based on child reports. Manifest variables for pregnancy exposure to IPV, pregnancy maternal mental

health, lifetime exposure to IPV, child report of current IPV, current maternal mental health, family history of depression and gender were included as predictors. Income was included in this model due to its association with child reports of depression. The early maternal sensitivity latent variable was also used as a predictor.

This model explained 37% of the variance of maternal reports of child depression (latent variable) and 34% of child's self-reported depression (latent variable). Model fit was good, χ^2 = 72.68, *df* = 57, *p* = .08; CFI = .96, RMSEA = .05, SRMR = .04, and indicators significantly loaded on latent variables in the expected direction (See Figure 3). Maternal reports of child depression were positively associated with child reports, *r* = .19, *p* = .03. Maternal reports of child depression were predicted by early maternal parenting, *standardized b* = .36, *p* = .02, maternal mental health during pregnancy, *standardized b* = .27, *p* = .01, current maternal mental health, *standardized b* = .23, *p* = .03, and child's report of current IPV, *standardized b* = .22, *p* = .03. Children's reports of depressive symptoms were predicted by IPV exposure during pregnancy, *standardized b* = .21, *p* = .05, and children's report of current exposure to IPV, *standardized b* = .38, *p* = .00. In addition, male gender predicted higher levels of child-reported depression, *standardized b* = -.28, *p* = .00. All other predictors had non-significant associations with the depression latent variables.

Hypothesis 3

HPA axis dysregulation (as indexed by salivary cortisol levels) was expected to predict higher levels of depressive symptoms, after controlling for familial (family history of depression), prenatal (maternal mental health), and postnatal risk (gender, early maternal parenting, maternal mental health, lifetime exposure to IPV, and income). Independent models were estimated using each of the indices of HPA axis functioning as predictors (i.e., decrease,

AuCg), to prevent multicollinearity problems due to high associations among the cortisol scores. Increase from baseline to peak and *AuCi* were not included in the models, as they failed to show correlations with child outcomes (See Table 3). Prenatal risk (pregnancy IPV and maternal mental health), postnatal risk (lifetime IPV, current IPV- child report, current maternal mental health, income), family history of depression, early maternal sensitivity, and gender were also included as predictors in all models.

The model including cortisol *decrease* explained 51% of the variance of maternal reports and 34% of the variance of self-reported child depression. This model had good fit indices, χ^2 = 76.87, *df* = 62, *p* = .10; CFI = .96, RMSEA = .05, SRMR = .04 (See Table 6), and all indicators loaded significantly on the latent variables in the expected direction (See Figure 4). Mother-reported child depression was again significantly correlated with child self-reports, *r* = .19, *p* = .02. Maternal reports of child depression were predicted by cortisol decrease, *standardized b* = .36, *p* = .00, maternal mental health during pregnancy, *standardized b* = .26, *p* = .01, early parenting, *standardized b* = .35, *p* = .02, maternal report of current mental health, *standardized b* = 30, *p* = .00, and family history of depression, *standardized b* = .18, *p* = .04. Child reports of depression symptoms were predicted by IPV exposure during pregnancy, *standardized b* = .21, *p* = .05, and child's report of current exposure to IPV, *standardized b* = .39, *p* = .00, predicted increased self-reported depression. In addition, male gender predicted higher levels of depression, *standardized b* = -.29, *p* = .00. All other predictors were non-significant.

The model including cortisol *AuCg* explained 47% of the variance of maternal reports of child depression and 34% of the variance of child reports of depressive symptoms. This model had good fit indices, χ^2 = 76.38, *df* = 62, *p* = .10; CFI = .96, RMSEA = .04, SRMR = .04 (See Table 6), and again, all indicators loaded significantly on the latent variables in the expected

direction. Cortisol *AuCg* was a significant predictor of mother-reported child depression, *standardized b* = .28, *p* = .00, as well as maternal mental health during pregnancy, *standardized b* = .28, *p* = .01, maternal early parenting, *standardized b* = .38, *p* = .01, maternal current mental health, *standardized b* = .27, *p* = .01, and income, *standardized b* = -.25, *p* = .03. Child reports of depression were predicted by child's report of current exposure to IPV, *standardized b* = .38, *p* = .00, and male gender, *standardized b* = -.28, *p* = .00. Pregnancy exposure to IPV displayed a trend to significance, *standardized b* = .21, *p* = .06 (See Figure 5). In sum, higher levels of cortisol *AuCg* and steeper decrease from peak to recovery were associated with higher levels of child depression as reported by mother. However, child reports of their own depressive symptoms were not associated with cortisol levels.

To test for differences in child depressive symptoms associated with different cortisol profiles (low, medium, or high cortisol), a MANCOVA using child reports and maternal reports of depression as dependent variables was used. Prenatal (pregnancy IPV and maternal mental health) and postnatal risk (lifetime IPV, current IPV- child report, current maternal mental health, and income) were also included as covariates. The model was significant for each of the outcomes, including levels of depression/withdrawal using the CBCL-maternal report, $F(8,110) = 4.50$, $p = .00$; the clinical interview–maternal report, $F(8,110) = 2.61$, $p = .01$; child report on the CDI $F(8,110) = 2.72$, $p = .01$; and child report on the BASC Depression Scale, $F(8,110) = 3.18$, $p = .00$.

To correct for the unequal variances of each depression score across the three groups, the White estimator (1980) was used and univariate ANCOVAs were conducted using the unstandardized residuals as weights. When maternal report on the CBCL was used as the independent variable, income, $F(1,110) = 5.26$, $p = .02$, Partial $\eta^2 = .05$; IPV during pregnancy,

$F(1,110) = 16.69$, $p = .01$, Partial $\eta^2 = 06$; maternal mental health during pregnancy, $F(1,110) = 6.29$, $p = .01$, Partial $\eta^2 = .05$; and latent profile membership, $F(1,110) = 11.23$, $p = .00$, Partial $\eta^2 = .17$, were all associated with differences in levels of depressive symptoms (See Table 7). Specifically, those in the high cortisol profile had higher levels of depression/withdrawal as compared to those in the low and medium cortisol profiles. Latent profile membership, $F(1,110) = 5.64$, $p = .01$, Partial $\eta^2 = .09$, was also associated with higher levels of depression based on the KSADS-MDD-maternal report of current symptoms. Again, those in the high cortisol class had higher levels of depression/withdrawal as compared to those in the low and medium cortisol classes. Only child's report of current IPV was associated with child's report of depressive symptoms (BASC), $F(1,110) = 11.06$, $p = .01$, Partial $\eta^2 = .09$. In sum, membership in the high-risk cortisol latent profile was associated with higher levels of mother-reported child depressive symptoms, after controlling for pregnancy and postnatal risk.

Hypothesis 4

The effect of prenatal IPV on childhood depressive symptoms is expected to be partially mediated through a dysregulated HPA axis stress response (as indexed by salivary cortisol levels). Models predicting both child depressive symptoms as reported by mother and child were estimated. Again, independent models were estimated for cortisol decrease and *AuCg*, which were the only cortisol scores associated with both risk and depression levels. These models included prenatal (pregnancy IPV and maternal mental health) and postnatal risk (lifetime IPV, current IPV-child report, current maternal mental health), as well as family history of depression, early parenting, and gender as predictors of both cortisol levels and depressive symptoms. In addition, cortisol levels were included as a predictor for both depression latent variables.

Finally, the indirect effects from the pregnancy risk to outcomes via cortisol levels were calculated using the Sobel test. Due to inconsistent associations with outcomes in the previous models, income was not used as a predictor in these models.

Figure 6 displays the mediation model using cortisol *decrease*. This model predicted 50% of the variance of the maternal report latent variable and 34% of the self-report child depression latent variable. Model fit was good, $\chi^2 = 63.16$, $df = 57$, $p = .27$; CFI = .98, RMSEA = .03, SRMR = .04 (See Table 6). Cortisol decrease was predicted by IPV exposure during pregnancy, *standardized b* = .26, $p = .01$, and child report of current IPV exposure, *standardized b* = .27, $p = .00$. Maternal report of child depression was predicted by cortisol decrease, *standardized b* = .36, $p = .00$, maternal early parenting, *standardized b* = .25, $p = .04$, maternal mental health during pregnancy, *standardized b* = .26, $p = .01$, and current maternal mental health, *standardized b* = .33, $p = .00$. Child report of depressive symptoms was predicted by male gender, *standardized b* = .29, $p = .00$, pregnancy exposure to IPV, *standardized b* = .22, $p = .04$, and child report of current IPV exposure, *standardized b* = .40, $p = .00$. The only significant indirect pathway was pregnancy IPV → cortisol decrease → maternal report of child depression, *standardized b* = .09, $p = .04$.

The mediation model using cortisol *AuCg* predicted 44% of the variance of the maternal report latent variable and 34% of the child report depression latent variable (See Figure 7). Model fit was good, $\chi^2 = 62.43$, $df = 57$, $p = .29$; CFI = .99, RMSEA = .03, SRMR = .04. Cortisol *AuCg* was only predicted by IPV exposure during pregnancy, *standardized b* = .22, $p = .05$. Maternal report of child depression was predicted by cortisol *AuCg*, *standardized b* = .25, $p = .01$, maternal early parenting, *standardized b* = .25, $p = .04$, maternal mental health during pregnancy, *standardized b* = .28, $p = .01$, current maternal mental health, *standardized b* = .31, *p*

= .00, and current child report of exposure to IPV, *standardized b* = .23, *p* = .02. Child report of depressive symptoms was predicted by male gender, *standardized b* = .28, *p* = .00, pregnancy exposure to IPV, *standardized b* = .21, *p* = .05, and child report of current IPV exposure, *standardized b* = .39, *p* = .00. None of the indirect pathways was significant. In sum, cortisol decrease mediated the association between prenatal IPV exposure and maternal report of child depression.

To test for qualitative differences in associations between risk and outcomes across children in the three different latent profiles, the models were also estimated without the 10 children in the high cortisol profile. Model fit was good for the model using *AuCg*, but fit indices worsened for the model using the decrease score. When the children in the high cortisol group were removed, the relationship between risk and cortisol output and the relationship between cortisol levels and depressive symptoms became non-significant. This preliminary analysis suggests that those with a profile of neuroendocrine risk may have a distinct profile of environmental risk and depressive symptoms.

Hypothesis 5

The effect of prenatal IPV may be moderated by gender and family history of depression. It was predicted that girls are more susceptible to the impact of prenatal stress than boys. In addition, those children with genetic predisposition (as indexed by family history of depression) are expected to be more susceptible to the impact of prenatal stress. Both variable- and person-oriented approaches were used to test this hypothesis. Differences between boys and girls as well as those with and without a history of depression were explored using t-test comparisons. Boys and girls were similar in all predictors, cortisol indices, and most depression scores; however, boys had more depressive symptoms as reported on the BASC Depression Scale.

Those with and without a family history of depression were also similar in most respects, but children with a family history of depression had higher levels of depressive symptoms as reported by mothers, and their mothers had higher levels of current depression. The groups were not different in any of the indices of salivary cortisol.

To assess the moderating role of gender, a 2-group model was proposed, which estimated different parameters for boys (n = 65) and girls (n = 54). Prenatal risk, postnatal risk, and family history of depression were used as predictors, while cortisol levels (i.e., decrease or *AuCg*) were included as a mediator. Model estimation revealed difficulties with the mother-report child depression latent variable; thus, the models were estimated only for the child-reported depression latent variable.

The model using cortisol decrease (See Figure 8) explained 39% of boys' and 36% of girls' variance on child-reported levels of childhood depression. Model fit was good, χ^2 = 82.15, df = 76, p = .29, CFI = .98, RMSEA = .04, RMSR = .07 (See Table 6). *For boys*, depression was only predicted by current levels of IPV, *standardized b* = .31, p = .03, while cortisol decrease was also only predicted by current levels of IPV, *standardized b* = .31, p = .02. *For girls*, less cortisol decrease, *standardized b* = -.28, p = .03, more pregnancy IPV, *standardized b* = .48, p = .00, and higher levels of current IPV, *standardized b* = .48, p = .00, were associated with depressive symptoms. Cortisol decrease was associated with IPV exposure during pregnancy, *standardized b* = .35, p = .02, and lifetime exposure to IPV, *standardized b* = -.33, p = .04. Based on the Sobel test, *standardized b* = .02, p = *ns* for boys and *standardized b* = -.10, p = *ns* for girls, there was no evidence of mediation.

The model using cortisol *AuCg* (See Figure 9) explained 40% of boys' and 36% of girls' variance on self-reported childhood depression. Model fit was good, χ^2 = 78.68, df = 76, p = .39,

CFI = .99, RMSEA = .02, RMSR = .07 (See Table 6). For *boys*, depression was only predicted by current levels of IPV, *standardized b* = .30, *p* = .02, while cortisol decrease was not predicted by any of the variables included in the model. For *girls*, less cortisol *AuCg*, *standardized b* = -.26, *p* = .04, more pregnancy IPV, *standardized b* = .47, *p* = .00, and higher levels of current IPV, *standardized b* = .43, *p* = .00, were associated with depressive symptoms. Cortisol *AuCg* was associated with IPV exposure during pregnancy, *standardized b* = .37, *p* = .02, and lifetime exposure to IPV, *standardized b* = .48, *p* = .00. Based on the Sobel test, *standardized b* = .02, *p* = *ns* for boys, and *standardized b* = -.10, *p* = *ns* for girls, there was no evidence of mediation.

To assess the moderating role of family history of depression, a 2-group model was estimated, which provided different parameters for those with (*n* = 50) and without (*n* = 69) family history of depression. Again, model estimation revealed difficulties with the mother-report child depression latent variable; thus, the models were estimated only for the child-reported depression latent variable. The model using cortisol *decrease* (See Figure 10) explained 27% of the variance of self-reported levels of childhood depression for those without a family history of depression, and 38% for those with a family history. Model fit was good, χ^2 = 81.85, *df* = 76, *p* = .30, CFI = .98, RMSEA = .04, RMSR = .06 (See Table 6). For those *without family history of depression*, child depression was predicted by male gender, *standardized b* = -.32, *p* = .00, and higher levels of current IPV, *standardized b* = .34, *p* = .01. Cortisol decrease was not predicted by any of the variables included in the model. For those *with a family history of depression*, male gender, *standardized b* = -.28, *p* = .04, more pregnancy IPV, *standardized b* = .34, *p* = .04, and higher levels of current IPV, *standardized b* = .52, *p* = .00, were associated with depressive symptoms. Cortisol decrease was associated with more current IPV exposure, *standardized b* = .39, *p* = .00, and less maternal current mental health problems, *standardized b* =

-.28, p = .04. Based on the Sobel test, there was no evidence of mediation for those without a family history of depression *standardized b* = .02, p = *ns,* or for children with a family history of depression, *standardized b* = -.10, p = *ns*.

The model using cortisol *AuCg* (See Figure 11) also explained 27% of the variance of self-reported levels of childhood depression for those without a family history, and 38% for those with a family history of depression. Model fit was good, χ^2 = 80.41, df = 76, p = .34, CFI = .99, RMSEA = .03, RMSR = .06. Similar to the previous model, for those *without family history of depression*, depression was predicted by male gender, *standardized b* = -.32, p = .00, and higher levels of current IPV, *standardized b* = .33, p = .01. Cortisol decrease was not predicted by any of the variables included in the model. For those *with a family history of depression*, male gender, *standardized b* = -.29, p = .03, more pregnancy IPV, *standardized b* = .36, p = .03, and higher levels of current IPV, *standardized b* = .52, p = .00, were associated with depressive symptoms. Cortisol decrease was associated with more pregnancy IPV exposure, *standardized b* = .36, p = .03, and less maternal current mental health problems, *standardized b* = -.28, p = .05. Based on the Sobel test, there was no evidence of mediation for children without a family history, *standardized b* = .00, p = *ns,* and those with a family history of depression, *standardized b* = -.03, p = *ns.*

DISCUSSION

The aim of this prospective longitudinal study was to evaluate the influence of prenatal exposure to IPV on the development of depressive problems during middle childhood (i.e., 10-year-old children), examining HPA axis functioning as a mechanism of risk transmission. The present study tested a model that integrates the early risk associated with exposure to IPV during pregnancy with a number of well established factors that convey vulnerability for childhood

depression including family history of internalizing problems, maternal mental health, maternal early parenting, and exposure to adversity during childhood. In addition, based on the "fetal programming" theory, the effect of IPV during pregnancy was expected to be mediated via changes in the offspring's neuroendocrine response to stressors, given the rapid development of the central nervous system in *utero*.

Results indicate that exposure to IPV during pregnancy predicted increased cortisol output and higher levels of child-reported depressive symptoms. Child report of recent exposure to IPV also was a significant predictor of higher levels of cortisol output and child depressive problems, as reported by both informants. In turn, increased cortisol output was associated with maternal reports of child depressive symptoms. Gender and family history of depression also emerged as moderating factors, such that exposure to IPV in *utero* was especially deleterious for girls and for those with a family history of depression. In the following sections, findings for each of the hypotheses will be discussed in detail. Limitations, future directions, and potential clinical implications are also delineated.

Child Stress-Induced Cortisol Levels

Average levels for the three indices of HPA axis functioning collected in the present study (baseline, peak, and recovery salivary cortisol) were consistent with those generally reported by previous research examining childhood depression and HPA axis response to a psychosocial stress manipulation (Hankin et al., 2010; Rao, Hammen, Ortiz, Chen, & Poland 2008; Spinrad et al., 2009). In contrast, cortisol levels in the present sample are higher than those reported among 9-14 year old children by Buske-Kirschbaum et al. (1997) using the same stress paradigm. Differences may be due to the high-risk nature and the potentially higher

percentage of children showing a hyperactive HPA axis response to stressors in the present sample.

As a group, children in the present study did not display the expected pattern of post-stressor cortisol increase. Other research studies have reported similar difficulties obtaining a reliable post-stressor increase (Dougherty et al., 2009; Spinrad et al., 2009). One possible explanation is that the manipulation task was not stressful enough to mobilize the HPA system among participants. However, children in this sample rated the stress-induction task as somewhat stressful (M = 3.24), with 37% of children giving a rating of "quite stressful" or higher and only 5% of children providing a rating of "not stressful at all." A second alternative is that participation in the assessment and arrival to the project office was an unfamiliar and stressful situation on its own for many children, mobilizing the stress response and making it difficult to obtain a "true" baseline measure. This is consistent with the initially high levels that decline when measured 40 minutes after the stress-induction task. However, current findings are difficult to interpret, as it is unclear if they reflect baseline levels or reactivity to stressors (laboratory visit and challenge task).

Although mean levels of cortisol were not consistent with HPA axis activation, some children did show the expected increase after the challenging task and return to baseline 40 minutes post-stressor. Person-oriented Latent Profile Analysis yielded three empirically derived profiles of stress-induced cortisol output, which were characterized by consistently low levels of cortisol, consistently medium levels of cortisol, and consistently high levels of cortisol. This third "high cortisol" profile also displayed increased levels 20 minutes post-stressor (peak), and an efficient return to low levels during the recovery period. One previous study found a similar pattern of results, such that the mean for the full sample failed to display the expected post-

stressor increase in cortisol levels, but a subgroup of children, with increased temperamental and familial risk, displayed the expected increase after the stress-inducing task (Dougherty et al., 2008). The pattern of HPA axis activation shown by this group is also consistent with the results of Zimmermann and Stansbury (2004) who found that temperamental reactivity was associated with elevations in the initial response to stress, but found no evidence of ineffective return to baseline or recovery after the threat was discontinued. This research, using a high-risk sample, is particularly relevant, as the ability to effectively regulate cortisol levels in response to environmental changes has been posited as an essential aspect of self-regulation and coping in the face of challenging stimuli (Gunnar & Donzella, 2002). In contrast, chronic HPA axis hyperactivity has been consistently linked to maladaptation; diverse deficits in basic mechanisms, such as arousal, attention, or memory (Erickson, Drevets, & Schulkin, 2003) result in maladaptive or inefficient coping responses.

Membership in the "high cortisol" group was predicted by pregnancy exposure to IPV, over and above prenatal, postnatal, and familial risk, providing support for the role of pregnancy as a sensitive period. Prenatal IPV was associated with higher overall and peak levels of cortisol output, suggesting that stress during gestation, during which the fetus undergoes rapid brain development, sets the foundation for the regulation of the stress response during childhood (Maccari et al., 2003; Huizink et al., 2004; Talge et al., 2007). IPV exposure during pregnancy can increase fetal exposure to cortisol, via chronically elevated cortisol levels among mothers (Field et al., 2004) and/or decreased levels of placental 11b-HSD2 enzyme (Glover et al., 2009), which metabolizes cortisol to its inactive form, reducing hormone levels in the placenta. Results are consistent with previous studies that provide evidence of a link between prenatal stress

exposure and offspring HPA axis regulation deficits (Grant et al., 2009; Gutteling et al., 2005; O'Connor et al., 2005).

In addition, prenatal IPV predicted child cortisol levels, whereas other prenatal factors (i.e., maternal prenatal mental health) were not associated with HPA axis functioning. The chronic and interpersonal nature of IPV results in high levels of shame, guilt, and negative self-cognitions among victims (Calvete et al., 2007; Street et al., 2005), exacerbating the neurobiological deficits that are associated with other stressors or depression and anxiety symptoms. The unique impact of IPV during pregnancy can also be understood given its influence on maternal representations of the infant (Huth-Bocks, Levendosky, Theran, et al., 2004), which are developed during pregnancy and are created in the context of other attachment relationships (including the relationship with the abuser). Maternal representations of the infant impact the emerging mother-child attachment (Huth-Bocks, Levendosky, Bogat, et al., 2004) and maternal parenting (Dayton et al., 2010), shaping the young child's ability to regulate cortisol levels to meet environmental and internal challenges.

The results of our study are consistent with the distinctive association reported by Bergman and colleagues (2007) between partner-specific stress and infant temperamental dysregulation, which was not significant for other stressful life events. IPV may be specifically associated with maternal HPA axis dysregulation and offspring in *utero* exposure to high levels of cortisol because of its chronic and interpersonal nature, increasing the victim's guilt, shame, and negative self-cognitions (Calvete et al., 2007; Street et al., 2005). Although this is the first study to examine the programming effects of IPV during pregnancy on offspring neuroendocrine functioning, results are consistent with multiple studies that provide evidence of the impact of IPV on women's cortisol output (Inslicht et al., 2006; Pico-Alfonso et al., 2004), and research

that has established a link between prenatal stress and offspring HPA axis dysregulation (Grant et al., 2009; Gutteling et al., 2005; O'Connor et al., 2005).

Membership in the "high cortisol" group was also associated with child reports of witnessing IPV, highlighting the influence of ongoing stressors on biological and behavioral functioning, as a result of the continued plasticity of the brain during childhood (Cushing & Kramer, 2005). IPV exposure may result in more frequent activation via the development of a lower threshold to mobilize the stress response. Cohen, Perel, DeBellis, Friedman, and Putnam (2002) have proposed that children exposed to traumatic events may have more frequent activation of the HPA axis (even in response to relatively mild stressors) due to an over-reactive amygdala, assigning threatening or stressful meaning to events more often than non-exposed children. Specific to IPV, research has also shown that very young children who have experienced interparental violence display heightened sensitivity to adult verbal conflict (DeJonghe, Bogat, Levendosky, von Eye, & Davidson, 2005), such that social stimuli that may not mobilize a stress response among control children, can result in chronic activation for those who have witnessed IPV.

Familial risk, income, gender, and maternal mental health (pre- and postnatal) were not significantly associated with group membership. These results are not entirely consistent with previous research, which has documented that elevated cortisol output is associated with maternal depression and low maternal sensitivity (Grant et al. 2009). However, previous studies have not controlled for prenatal exposure to traumatic stress, which is also associated with maternal depression and parenting, and may be uniquely contributing to the development of depressive symptoms among the present sample.

Structural equation models (SEM) were used to test for linear associations among the full sample. Area under the Curve with respect to Ground (*AuCg*) was used as an indicator of total cortisol output during the laboratory visit. Similar results were obtained: prenatal exposure to IPV was the only predictor of *AuCg*. Again, IPV during pregnancy had an important effect over and above levels of prenatal maternal depression and anxiety, emphasizing the unique influence of intimate partner abuse. Cortisol decrease (peak – recovery) was proposed as an indicator of inefficient termination of the stress response (i.e., smaller decrease results in prolonged CNS exposure to high cortisol levels). Cortisol decrease was predicted by pregnancy IPV, as well as child report of current IPV (at age 10). However, the associations were opposite to expectations: exposure to IPV predicted a steeper decrease from peak to recovery. Previous studies have failed to document an association between prolonged HPA axis activation and adversity or depressive symptoms during childhood. Thus, the reason for the pattern of association observed in this study is unclear. Possibly, within the present sample, a larger decrease score reflects higher peak levels, rather than more efficient termination. This alternative is consistent with the strong correlation between *AuCg* and cortisol decrease (r = .80). Notably, the prenatal, posnatal, and familial factors only accounted for about 5% of the variability in cortisol scores, which is consistent with previous reports of significant individual differences in HPA axis activation (Gunnar, Sebanc, Tout, Donzella, & van Dulmen, 2003).

Although results of the SEM models are difficult to interpret due to the lack of mobilization of the HPA axis response after the stress-induction task, results consistently point to an association between higher levels of cortisol output and pregnancy IPV as well as current reports of IPV. Although high levels of circulating cortisol can be protective against immune, infectious, and inflammatory diseases (Kapcala et al., 1995), frequent exposure to cortisol,

resulting from higher baseline levels or increased reactivity to stressors, can lead to brain function abnormalities, including impaired threat signal detection or inefficient regulation of pleasure and motivation systems (Goodyer, 2008).

Child Depression and Familial, Prenatal, and Postnatal Risk

Consistent with a developmental psychopathology framework, child depressive symptoms were predicted by multiple individual and family risk and protection. Among this high-risk sample of school-age children, 21% experienced borderline or clinical levels of depressive problems, as reported by either the child or his/her mother. Maternal and child reports of current depressive symptoms displayed non-significant to small associations (r = .19 to r = .21 for latent factors). Although this level of agreement is somewhat low, it is similar to that reported by most studies, including Achenbach, McConaughy, and Howell's (1987) comprehensive meta-analysis (r = .25).

Discrepancies between parent and child report of internalizing symptoms are well documented (Briggs-Gowan, Carter, & Schwab-Stone, 1996). Some studies have found that children tend to report more internalizing symptoms than their parents (Edelbrock, Costello, Dulcan, Conover, & Kala, 1986; Hodges, Gordon, & Lennon, 1990), whereas other studies report that depressed mothers tend to over-report their children's internalizing problems (Kiss et al., 2007; Renouf & Kovacs, 1994). Consistency across reporters may also be influenced by individual and familial risk; for example, maternal psychopathology can influence child-mother symptom agreement (Morrel et al., 2003; Youngstrom, Loeber, & Stouthamer-Loeber, 2000). Because mother and child reports may provide distinct information about children's functioning in different settings, information from both reporters was included simultaneously in the models.

To tease apart the influence of maternal psychopathology, maternal current depression and anxiety symptoms were statistically controlled for in all models.

Structural equation models including prenatal, postnatal, and family risk provided a good fit for the data. However, different risk factors had specific associations with maternal and child reports of depression. Notably, child report of IPV exposure during the previous year was the only risk factor that significantly predicted depressive symptoms as reported by both mother and child, with similar effect sizes as those reported for internalizing symptoms in two meta-analyses (Wolfe et al., 2003; Kitzmann et al., 2003). The effect of exposure to IPV on depressive levels during childhood is consistent with the life stress theory (Cicchetti & Toth, 1998), such that exposure to traumatic stress both hinders the development of regulatory and coping capacities that are needed for facing environmental challenges and may trigger pre-existent vulnerabilities. Witnessing IPV exposes the child to maladaptive models for modulation of emotional arousal and poor behavioral regulation, which the child may utilize within interpersonal relationships with poor outcomes, potentially reinforcing negative self-cognitions and reducing social supports. In addition, exposure to IPV can increase the risk for depression as it increases the likelihood of additional life stressors, such as difficult child temperament, maternal depression, and ineffective parenting (Martinez-Torteya, Bogat, von Eye, & Levendosky 2009; Eby, 2004; Levendosky et al., 2006), which may overwhelm the already vulnerable regulatory capacities of the child exposed to IPV.

Similar to the findings with HPA axis regulation, evidence supports the role of the prenatal environment on the development of depression during childhood. Child-reported levels of depression were predicted by pregnancy IPV, while maternal reports of child depression were associated with maternal mental health during pregnancy. These findings do provide support for

pregnancy as a *sensitive period* for emotional adaptation during childhood, as the prenatal environment was a significant predictor over and above the impact of more recent stressors. Results are similar to those reported by O'Connor and colleagues (2002, 2005) who found higher levels of internalizing symptoms at ages 4 and 7 among children of mothers with high levels of anxiety during pregnancy. Results are also consistent with those of Van den Bergh et al. (2008), who found that maternal stress during pregnancy predicted adolescent depressive symptoms. In contrast with the findings for HPA axis regulation, depression during childhood was not uniquely associated with pregnancy IPV. Consistent with the principle of equifinality, children develop depressive symptoms as a result of multiple pathways, including general adversity during pregnancy as well as traumatic interpersonal stress. Specific clinical presentations across children that develop depression via different pathways require further exploration.

Consistent with extant research, current maternal mental health was associated with mother reports of child depression (Connell & Goodman, 2002; McLeod et al., 2007). Mothers who experience depressive or anxiety symptoms model maladaptive coping strategies, as well as poor affect and behavior regulation (Goodman & Gottlieb, 1999). In addition, depressed and anxious mothers display less effective parenting, including poor monitoring and less sensitivity (Lovejoy et al., 2000).

In contrast, the significant relationship between early parenting and mother reports of child depression was in the opposite direction from expectations. Maternal sensitive early parenting was hypothesized to promote the development of self-regulation (Jennings et al., 2008) and protect against the development of depression. Maternal sensitivity has been linked to positive child outcomes, particularly in the context of maternal depression, buffering its negative impact on child adaptation. However, maternal sensitivity may also be associated with a more

accurate perception of childhood depressive symptoms. Some studies indicate that parents may under-report their children's depressive symptoms (Edelbrock et al., 1986; Hodges et al., 1990), but mother-child agreement is also influenced by individual and relational factors, such as maternal mental health (Morrel et al., 2003) and perhaps maternal sensitivity. The relationship between maternal sensitivity and childhood depression may also be an artifact of reporter bias and needs further evaluation and replication before conclusions can be drawn.

Child Cortisol Levels and Depressive Symptoms

Goodyer (2008) has proposed high levels of cortisol as a biomarker for deficits in threat signal detection, which result in rapid and intense negative emotionality in response to incoming stimuli, as well as inefficient regulation of pleasure and motivation, which result in low positive emotionality (Caspi et al., 1996). Results revealed that overall cortisol output during the laboratory visit (*AuCg*) and larger decrease from peak to recovery levels predicted more mother-reported levels of child depression. Similarly, maternal reports of child depression were also higher for those in the "high cortisol" profile, such that depression was associated with mobilization of the stress response after the stress-induction task (peak), in addition to overall high levels of cortisol. Group membership accounted for 6% to 8% of the variance of mother reports of childhood depression, using multiple methods (clinical interview and questionnaire). Hyper-reactivity to stressors or high baseline cortisol levels perhaps result in continued tissue exposure to the deleterious catabolic effects of cortisol. Cortisol-induced disruptions in the threat signal detection system (amygdala and associated ventral prefrontal areas) and pleasure/motivation regulation system (hippocampus, nucleus accumbens and ventral tegmental area) can then result in the increased negative affect and anhedonia that characterize depression.

Self-reported levels of childhood depression were not associated with baseline, peak, recovery levels, or total cortisol output. These negative findings are consistent with those of Birmaher, Dahl, et al. (1996), suggesting that the HPA axis regulation deficits observed in adult depressed samples do not emerge until puberty or adolescence. However, negative findings in the present sample may also be a function of the variable-oriented approach used in modeling, as parameters were estimated for the complete sample, aggregating all subjects in one group. In contrast, the moderation models described in the following section may provide a more nuanced characterization of subgroups of children.

Results partially support the mediating role of HPA axis dysregulation, as increased reactivity and total cortisol output predicted increased risk for child depressive symptoms. However, pregnancy IPV, maternal mental health during pregnancy, maternal early parenting, current IPV exposure, maternal current mental health, and cortisol levels all independently predicted increased depressive symptoms for children and specific mediation tests evaluating the indirect effect were not significant. Results suggest that the coping disruptions associated with ineffective regulation of cortisol output may not be distinctively linked with depressive symptoms, and require the influence of other environmental and familial risk to be expressed as depressive problems. Alternatively, capturing the stress regulation deficits that are specifically linked to depression may require measuring complex interactions within the CNS and sympathetic nervous system (SNS) response. For example, the ratio between cortisol and the adrenal steroid dehydroepiandrosterone (DHEA) has been proposed as a better index of risk for depression (Young, Gallagher, & Porter, 2002), while levels of salivary alpha-amylase (sAA) reflect SNS activation and are more sensitive to psychological stressors (van Stegeren, Wolf, & Kindt, 2008). In addition, the "programming" impact of IPV likely disrupts other biological and

psychosocial processes that were not assessed in the present study, such as hippocampal functioning, which may be closely linked to the information processing pleasure regulation deficits characteristic of depressed children (McKinnon, Yucel, Nazarov, & MacQueen, 2009), or maternal representations of the infant (Huth-Bocks, Levendosky, Theran, et al., 2004), which disrupt secure mother-child attachment (Huth Bocks, Levendosky, Bogat, et al., 2004) and effective maternal parenting (Dayton et al., 2010), increasing risk for depressive problems.

Moderation by Gender and Family History

It is well established that the etiology of childhood depression is multifactorial and results from interactions among genetic, individual and environmental factors (Downey & Coyne, 1990; Eley et al., 2004; Kaufman et al., 2006; Rice et al., 2006). Preliminary analyses supported an interaction between family history of depression and exposure to IPV *in utero,* predicting both total cortisol output and depressive symptoms. This finding suggests that prenatal IPV may act as an epigenetic mechanism (Goodyer, 2008), activating children's familial vulnerability and resulting in increased cortisol secretion and depressive problems. Additional environmental stressors, such as current levels of IPV and maternal distress also contributed to the development of HPA axis regulation deficits and depressive symptoms in the context of familial vulnerability, supporting a gene-environment interaction that is consistent with multiple previous studies of depressed youth (Kaufman et al., 2006; Rice et al., 2006). However, findings should be interpreted with caution due to small group sizes.

Moderation by gender was also supported. Different risk mechanisms may be involved in the development of depressive symptoms as reported by boys and girls. Boys' depressive symptoms were only predicted by their report of current IPV exposure. In contrast, girls' depressive symptoms were predicted by exposure to IPV during pregnancy, current exposure to

IPV, and cortisol output. Results are consistent with previous studies that suggest that females are more susceptible to express the "programming effects" of stress during pregnancy through dysregulation of the stress response and depressed or anxious behavior (Weinstock, 2007). Specifically, results partially replicate those of Van den Bergh et al. (2008), who reported that antenatal maternal anxiety was only associated with depressed mood among female adolescents, and this effect was partially mediated via a flattened diurnal cortisol profile and overall higher daily cortisol secretion. Contrary to the pattern that emerged for maternal reports of childhood depression, higher levels of lifetime IPV predicted a smaller cortisol decrease from peak to recovery and lower total cortisol output, which in turn predicted higher self-reported depressive problems among girls.

Although results are preliminary due to the small sample size for each group, they may represent important distinctions between cortisol reactivity and specific depressive symptoms, which may be more or less likely to be reported by mothers vs. children or boys vs. girls. For example, Luby et al. (2003) reported that anhedonic depressed preschoolers (i.e., those who endorsed inability to experience pleasure or had markedly diminished interest in most activities) showed a decrease in cortisol from baseline to post-stress levels, while the levels among hedonic depressed preschoolers were not different from the control group or children with other psychiatric problems. Different profiles of risk may also be associated with psychiatric co-morbidity. For example, DeBellis and colleagues (1996) reported that depressed traumatized children exhibited a characteristic pattern of low cortisol output.

Limitations and Future Directions

The present prospective longitudinal study is the first to explore the long-term programming effect of prenatal IPV on children's psychological outcomes, adopting a disorder-

specific perspective and evaluating HPA axis functioning as a neuroendocrine mechanism of risk transmission in the context of well-established familial, prenatal, and postnatal risk factors. This study utilized a multi-method, multi-informant approach, enhancing external validity and potential generalization of the present results. Moreover, data analyses were conducted using both variable- and person-oriented approaches, such that conclusions can be derived about mean levels of depressive symptoms, as well as relationships that may be specific to homogeneous subgroups of children. In addition, this study retained during 10 years of data collection more than 57% of the women who were originally recruited, and participants of the present study were very similar to the original high-risk sample. However, the limitations of this study should be noted and considered when evaluating the results obtained.

First, this study assessed HPA axis response to stressors using a social and performance stress-induced manipulation. However, other studies with depressed children have reported more consistent associations between cortisol levels and depressive symptoms using a biological challenge (i.e., dexamethasone suppression test) or evaluating the daily profile of resting cortisol output (i.e., flattened profile is associated with risk; Lopez-Duran et al., 2009). Future studies would benefit from specifying the differential impact of prenatal IPV on these different indices of HPA axis functioning, as well as potential developmental or temporal effects. For example, in their cross-sectional study, Hankin and colleagues (2010) reported that depression is correlated with a blunted cortisol response among toddlers and a heightened response among teenagers, but no study to date has characterized children's HPA axis functioning over time, to determine fluctuations in children's HPA system and its associations with depressive symptoms at different developmental periods.

Second, this study provides evidence for the programming role of prenatal IPV on long-term HPA axis reactivity to stressors and the development of depressive symptoms, but does not address the specific etiology of this programming effect. Animal research suggests that increased levels of maternal cortisol and/or decreased levels of maternal placental enzyme 11b-HSD2 may be directly responsible for the long-term organizational effects of stress during pregnancy. However, maternal cortisol or enzyme levels during pregnancy were not available in the present research. Future studies can provide a comprehensive understanding of the neurobiological deficits associated with prenatal IPV by assessing cortisol and enzyme levels among pregnant women.

In addition, some measurement and modeling issues should be noted. Family history of depression was assessed solely by maternal report in the present study, which may have resulted in inaccurate reports of risk on the paternal side. Given the nature of this research and potential safety concerns, the child's father was not invited to participate in the study, preventing the research team from gathering more precise family history data. Results based on this measure should be interpreted with caution. Future research would benefit from integrating father reports when studying depressive problems among children exposed to prenatal IPV. In addition, the sample size prevented examination of more complex interactions between different risk and protective factors. For example, moderation by gender and family history could not be explored using the 3 empirically-derived latent profiles, given the small size of two of these groups. Similarly, differences in the relationship between cortisol levels and depression among different groups of girls (e.g., with co-morbid psychiatric problems or traumatized) could not be explored due to small sample size for each gender. Future research, using larger samples, would benefit

from examination of potentially different subgroups of children exposed to IPV in *utero* who develop depressive symptoms.

Clinical Implications

Research investigating the mechanisms through which prenatal exposure to IPV may result in depressive problems during childhood has the potential to reveal avenues for early prevention and intervention efforts, including psychoeducation, skills-based, or pharmacological approaches. Although factors that predict individual differences in response to IPV exposure in *utero* remain to be examined, the present study suggests that IPV exposure during pregnancy is associated with increased offspring HPA axis reactivity, as indexed by higher levels of cortisol output in response to a mild stressor, as well as higher levels of depressive symptoms. Increased risk among this group of children highlights the importance of identifying women who are victimized during pregnancy. Research suggests that a large number of women who experience IPV do not seek services to cope with the abuse experienced (Fugate, Landis, Riordan, Naureckas, & Engel, 2005); thus, routine IPV screenings during prenatal care visits may be the most effective way to link abused pregnant women with appropriate services. Psychoeducation for prenatal care providers may improve identification of women exposed to IPV during pregnancy and facilitate early intervention.

The impact of IPV exposure during pregnancy on levels of childhood depression and associated dysregulation of the physiological response to stressors appeared to be most pronounced for girls. Although the reason for this increased risk is unclear, prevention and intervention efforts that focus on stress reactivity and emotion regulation may be particularly effective among young girls exposed to IPV in *utero*. Finally, the present study also suggests

maternal early parenting as a fruitful avenue for intervention among women exposed to IPV during pregnancy.

Conclusion

The present study underscores the interplay of multiple factors at the biological, individual, and family levels that contribute to increased risk for depression. This is the first prospective longitudinal study to examine the long-term biological and psychological impact of exposure to IPV in *utero,* while accounting for relevant familial, prenatal and postnatal risk as evaluated via multiple methods and informants. Exposure to IPV during pregnancy was directly associated with increased cortisol output in response to psychosocial stress, as well as child reports of depressive symptoms. Cortisol levels were also associated with concurrent exposure to IPV (at age 10), highlighting the plasticity of the HPA system throughout childhood. In turn, increased cortisol output was associated with maternal reports of child depressive symptoms, but most models did not support mediation between IPV during pregnancy and depressive symptoms during childhood. Gender and family history of depression emerged as moderating factors. Consistent with previous research on prenatal stress, exposure to IPV in *utero* was especially deleterious for girls. In addition, pregnancy IPV was only associated with increased risk for HPA axis dysregulation and depression among those with a family history of depression, suggesting that prenatal IPV may act as an epigenetic mechanism that amplifies familial risk.

APPENDICES

APPENDIX A

Tables

Table 1
Demographics for Full and Reduced Samples With t-test Comparisons

	Original Sample *N* = 206	Study Sample *N* = 119	*P*
Gender	51% Boys 49% Girls	55% Boys 45% Girls	.26
Ethnicity	46% White/Caucasian 24% Black 23% Multiracial 2% Latino 2% Native American 1% Asian American	50% White/Caucasian 23% Black 23% Multiracial 2% Latino 1% Native American 1% Asian American	.55
Maternal Education	45% some HS 35% some college 15% BA/BS 5% graduate education	39% some HS 42% some college 11% BA/BS 6% graduate education	.09
Maternal Marital Status	50% single/never married 40% married 10% separated/divorced/ widowed	45% single/never married 44% married 11% separated/divorced/ widowed	.19
Family Income	*M* = $1,823 *SD* = $1,507	*M* = $2,002 *SD* = $1,652	.04
Maternal Age	*M* = 25 *SD* = 5	*M* = 26 *SD* = 5	.31

Table 2
Measures Across All Data Collection Periods

	Preg	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 10
IPV- Mother Report	X	X	X	X	X	X	X	X	X
Maternal Depression	X								X
Maternal Anxiety	X								X
Maternal Parenting		X	X	X					
Family History of Depression				X					
Income									X
IPV- Child Report									X
Child Depression									X
Salivary Cortisol									X

Table 3
Correlations Between All Predictors and Outcomes

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.Family Hist MDD	.13	.13	.09	.06	-.01	-.01	.08	.01	*.30*	-.01	*.27*	*.20*	-.01	-.13	-.04	.04	.07	-.07
2.Preg Mom Mental Health		*.37*	-.11	-.18	-*.27*	-*.28*	*.25*	.07	*.39*	-*.26*	*.29*	.18	.09	.12	-.09	.02	-.04	-.08
3.Preg IPV			-.08	-.16	-*.24*	-*.32*	*.42*	.11	*.29*	-*.27*	.12	.11	*.21*	*.21*	-.05	.15	.11	-.03
4.Sensit Age 1						*.43*	-.12	-.08	-.04	*.31*	.09	-.07	.02	-.02	-.03	-.03	.00	-.03
5.Nurt Age 1						*.35*	-*.27*	-.17	-.13	*.50*	.09	-.05	-.02	-.15	.13	.03	.06	.12
6.Nurt Age 2						*.29*	-*.34*	-.11	-.16	*.41*	.11	-.03	-.13	-*.21*	.11	.05	.04	.10
7.Nurt Age 3							-*.43*	-*.20*	-*.24*	*.53*	.01	-.03	-*.23*	-*.30*	-.04	-.05	.01	-.04
8.Lifetime IPV								*.39*	*.21*	-*.27*	.14	.07	*.22*	*.33*	-.03	-.02	-.05	-.03
9.Current IPV- Child									.16	-*.25*	*.24*	.15	*.39*	*.28*	.16	*.19*	.05	.12
10.Curr Mom Mental Health										-*.32*	*.35*	*.30*	.06	.04	-.08	-.06	-.07	-.06
11.Current Income											-.16	-.13	-*.19*	-*.23*	.10	-.04	.13	.10
12.CBCL With/ Dep												*.50*	*.19*	*.25*	-.03	*.30*	.17	-.09
13.KSADS MDD													.14	.16	.04	*.27*	*.22*	-.01
14.BASC Depression														*.63*	.00	.08	.03	.00
15.CDI Total															.06	.09	-.02	.07
16.Cort Incr																*.44*	.14	.97
17.Cort Decr																	*.80*	.26
18.Cort AuCg																		-.04
19.Cortl AuCi																		

* $p < .05$

Table 4
Latent Profile Analysis Using Baseline, Peak, and Recovery Cortisol Levels

	Free param	N	Log-likelihood	AIC	BIC	Adj BIC	Entropy
1 Latent Profile	6	N = 119	564.87	-1117.74	-1101.07	-1120.04	
2 Latent Profiles	10	LP1 =93 LP2 =26	674.43	-1328.85	-1301.06	-1332.68	.94
3 Latent Profiles	14	LP1 = 88 LP2 = 20 LP3 = 11	710.76	-1393.53	-1354.62	-1398.88	.97
4 Latent Profiles	18	LP1 = 87 LP2 = 11 LP3 = 14 LP4 = 7	723.57	-1411.14	-1361.12	-1418.03	.95

Table 5
Logistic Regression Predicting Cortisol Latent Profile Membership

	Low Cortisol (*n* = 88)		Medium Cortisol (*n* = 20)	
	B	OR (CI_{95})	*B*	OR (CI_{95})
Gender	-1.25	.29 (.05-1.71)	-1.90	.15 (.02-1.15)
Family History of MDD	.00	.99 (.19-5.22)	-.12	.89 (.13-6.12)
Pregnancy IPV	-.18	.84 (.73-.96)	-.30	.74 (.58-.95)
Pregnancy Maternal Mental Health	.03	1.03 (.93-1.14)	.02	1.02 (.91-1.14)
Lifetime IPV	.01	1.01 (.99-1.03)	.01	1.01 (.97-1.04)
Current IPV- Child Report	-.15	.86 (.77-.96)	-.31	.73 (.61-.89)
Current Maternal Mental Health	.05	1.05 (.95-1.17)	.02	1.02 (.91-1.14)
Maternal Early Parenting	-.19	.82 (.67-1.01)	-.30	.74 (.59-.93)

Note. *LR*- $\chi^2(220, N = 119) = 194.88$, $p = .89$; Pearson $\chi^2(220, N = 119) = 142.38$, $p = 1.00$ Nagelkerke $r^2 = .32$. Reference group = High Cortisol (*n* = 10)

Table 6
Fit Indices for Models Predicting Childhood Depression

Predictors	*df*	χ^2	CFI	RMSEA	SRMR	AIC	Adj BIC	r^2
Prenatal and Postnatal Risk	56	72.68	0.96	0.05	0.04	12376.44	12360.00	M = .37 C = .34
Decrease, Prenatal and Postnatal Risk	62	76.87	0.96	0.05	0.04	11915.01	11897.42	M = .51 C = .34
AuCg, Prenatal and Postnatal Risk	62	76.38	0.96	0.04	0.04	12974.12	12956.54	M = .47 C = .34
Mediation: Decrease, Prenatal and Postnatal Risk	57	63.16	0.99	0.03	0.04	9753.23	9733.74	M = .50 C = .34
Mediation: *AuCg*, Prenatal and Postnatal Risk	57	62.43	0.99	0.03	0.04	10816.42	10796.93	M = .44 C = .34
Mediation by Gender: Decrease, Prenatal and Postnatal Risk	76	82.15	0.98	0.04	0.07	8218.01	8193.55	B = 39 G = 36
Mediation by Gender: *AuCg*, Prenatal and Postnatal Risk	76	78.68	0.99	0.02	0.07	9281.74	9257.28	B = .40 G = .36
Mediation by Family History of MDD: Decrease, Prenatal and Postnatal Risk	76	81.85	0.98	0.04	0.06	8235.31	8210.85	FH+ = .38 FH- = .27
Mediation by Family History of MDD: *AuCg*, Prenatal and Postnatal Risk	76	80.41	0.99	0.03	0.06	9286.99	9262.52	FH+ = .38 FH- = .27

Table 7
Hypothesis 3: MANCOVA for Differences on Maternal and Child Reports Across 3 Latent Profiles of Cortisol

Source	*df*	*F*	*Partial* η^2	*p*
CBCL With/Dep – Mother				
Model	9	4.50	.25	.00
Pregnancy IPV	1	1.20	.01	.28
Pregnancy Maternal Mental Health	1	4.54	.04	.04
Lifetime IPV	1	.04	.00	.85
Current IPV- Child Report	1	1.31	.01	.25
Current Maternal Mental Health	1	7.75	.07	.01
Income	1	.12	.00	.73
Latent Profile (3)	2	4.52	.08	.01
Error	110	35.29		
KSADS-MDD Current - Mother				
Model	8	2.61	.16	.01
Pregnancy IPV	1	.00	.00	.95
Pregnancy Maternal Mental Health	1	.55	.01	.46
Lifetime IPV	1	.20	.66	.00
Current IPV- Child Report	1	1.17	.01	.28
Current Maternal Mental Health	1	7.38	.06	.01
Income	1	.21	.00	.65
Latent Profile (3)	2	3.43	.06	.04
Error	110	7.35		
CDI Total Tscore – Child				
Model	8	2.72	.17	.01
Pregnancy IPV	1	.78	.01	.38
Pregnancy Maternal Mental Health	1	.18	.00	.67
Lifetime IPV	1	3.59	.03	.06
Current IPV- Child Report	1	3.15	.03	.08
Current Maternal Mental Health	1	1.47	.01	.23
Income	1	1.63	.02	.20
Latent Profile (3)	2	.13	.00	.88
Error	110	52.85		
BASC Depression Scale - Child				
Model	8	3.18	.19	.00
Pregnancy IPV	1	2.37	.02	.13
Pregnancy Maternal Mental Health	1	.00	.00	.96
Lifetime IPV	1	.00	.00	.95
Current IPV- Child Report	1	13.01	.11	.00
Current Maternal Mental Health	1	.41	.00	.52
Income	1	.59	.01	.44
Latent Profile (3)	2	.01	.00	.99
Error	110	6.75		

APPENDIX B

Figures

Figure 1

Hypothesis 1: Proposed Model Predicting Salivary Cortisol Levels Using Prenatal and Postnatal Risk

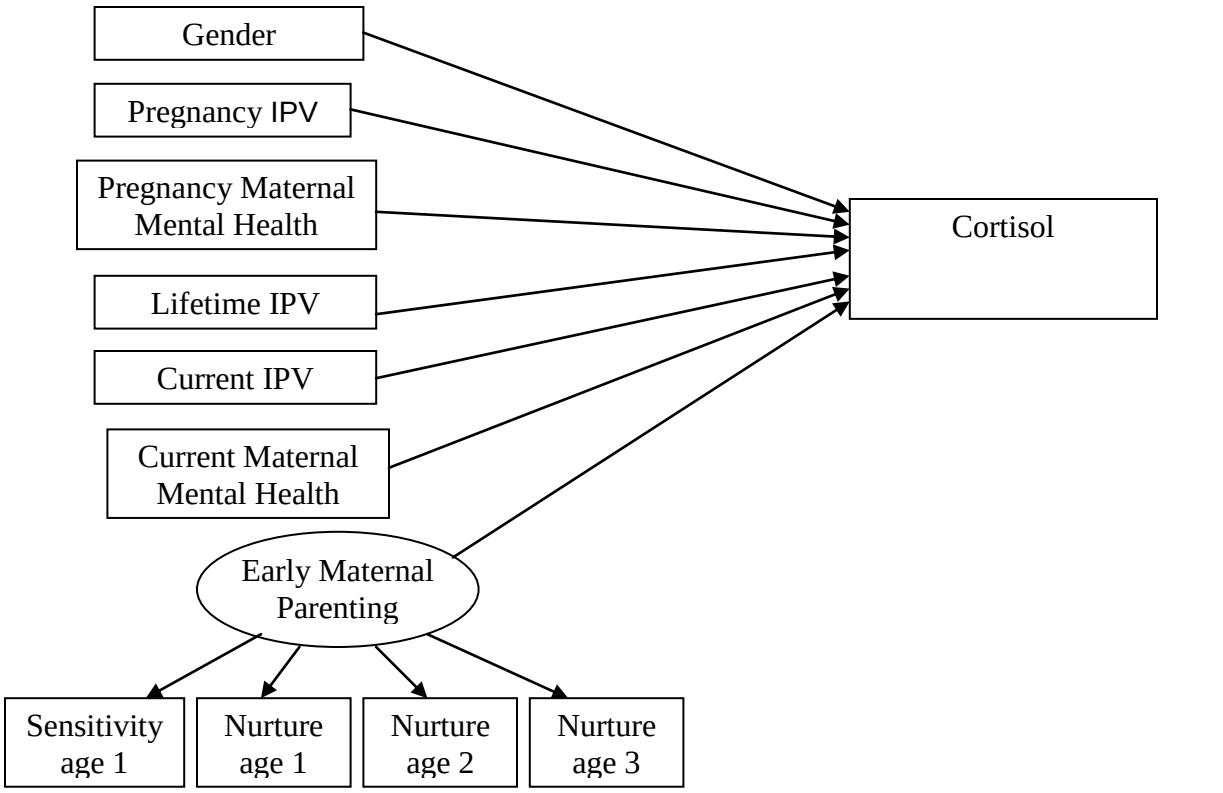


Figure 2
Three-Latent Profiles of Cortisol Output

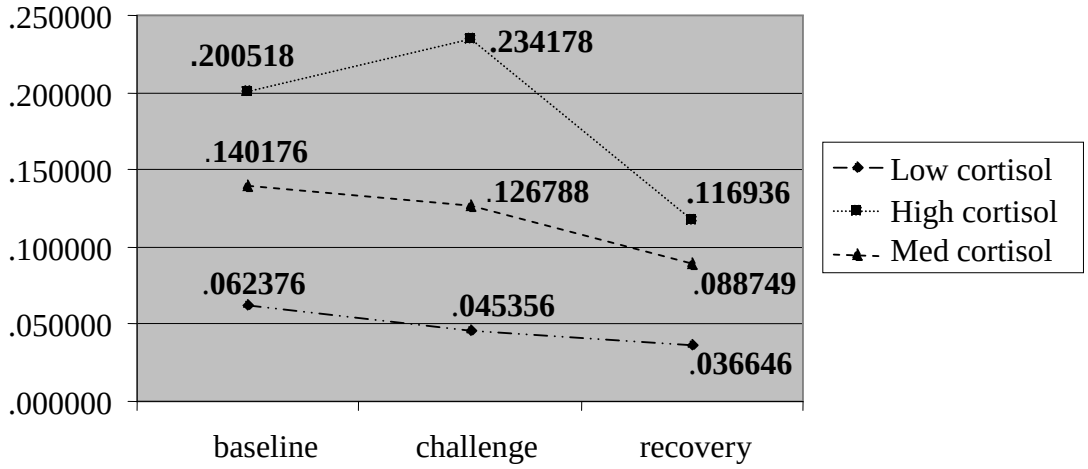


Figure 3

Hypothesis 2: Estimated Model Predicting Child Depression Using Prenatal and Postnatal Risk

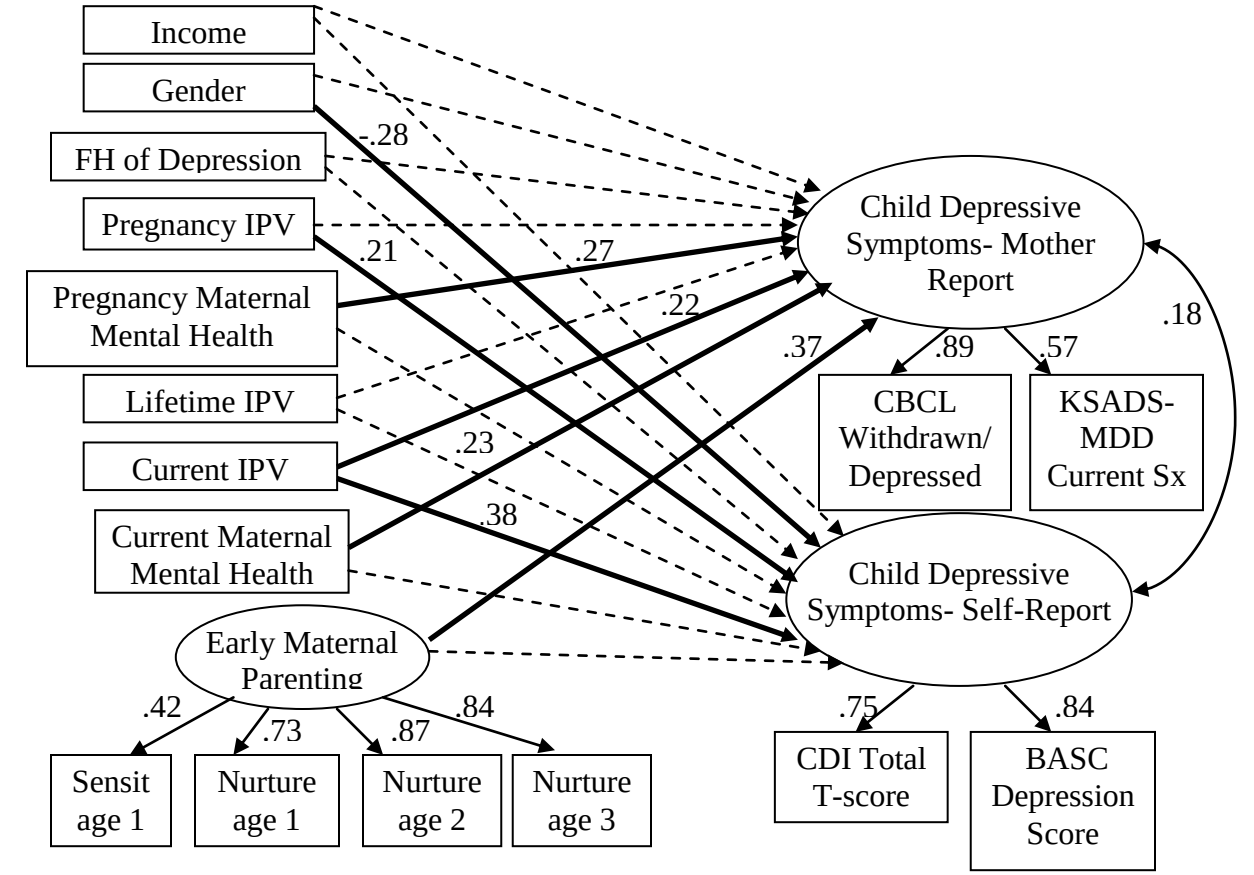


Figure 4

Hypothesis 3: Estimated Model Predicting Child Depression Using Cortisol Decrease, Prenatal and Postnatal Risk

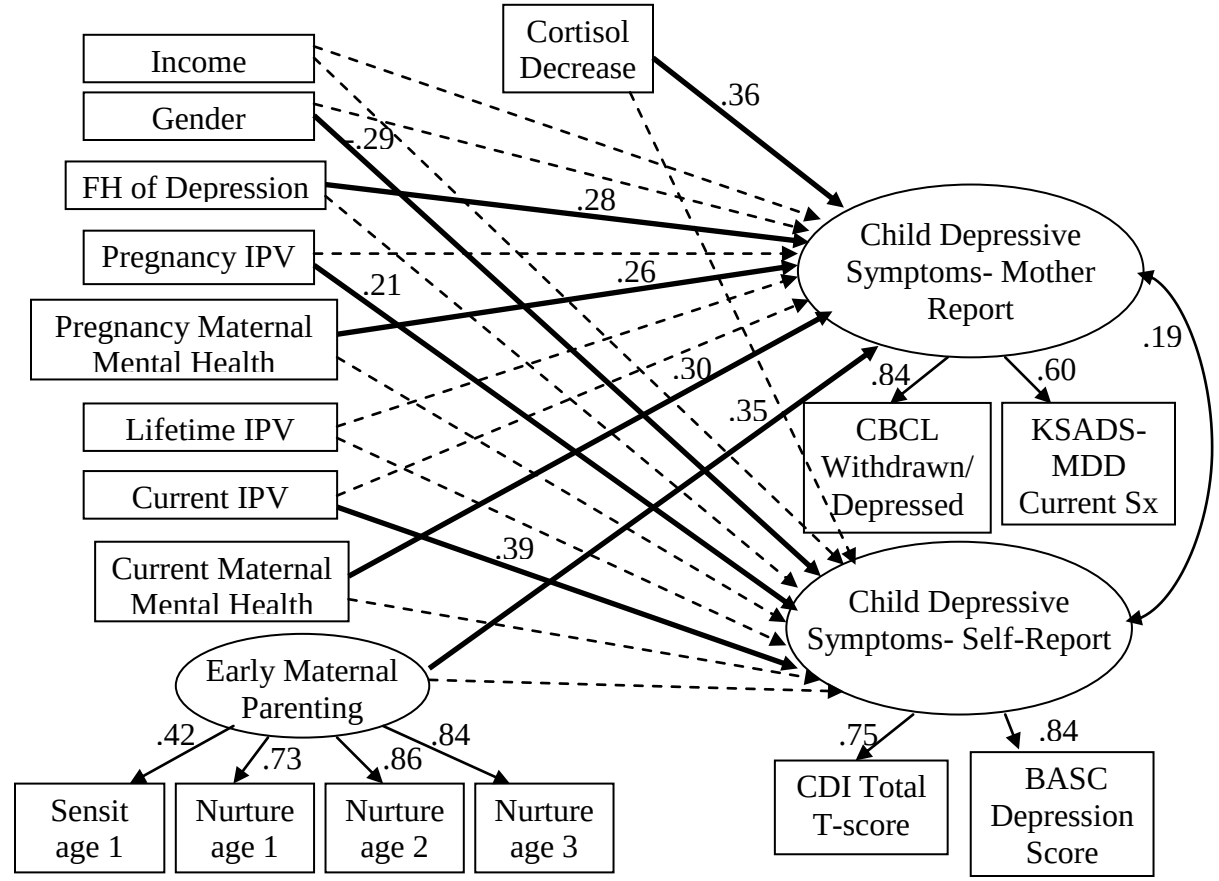


Figure 5

Hypothesis 3: Estimated Model Predicting Child Depression Using Cortisol AuCg, Prenatal and Postnatal Risk

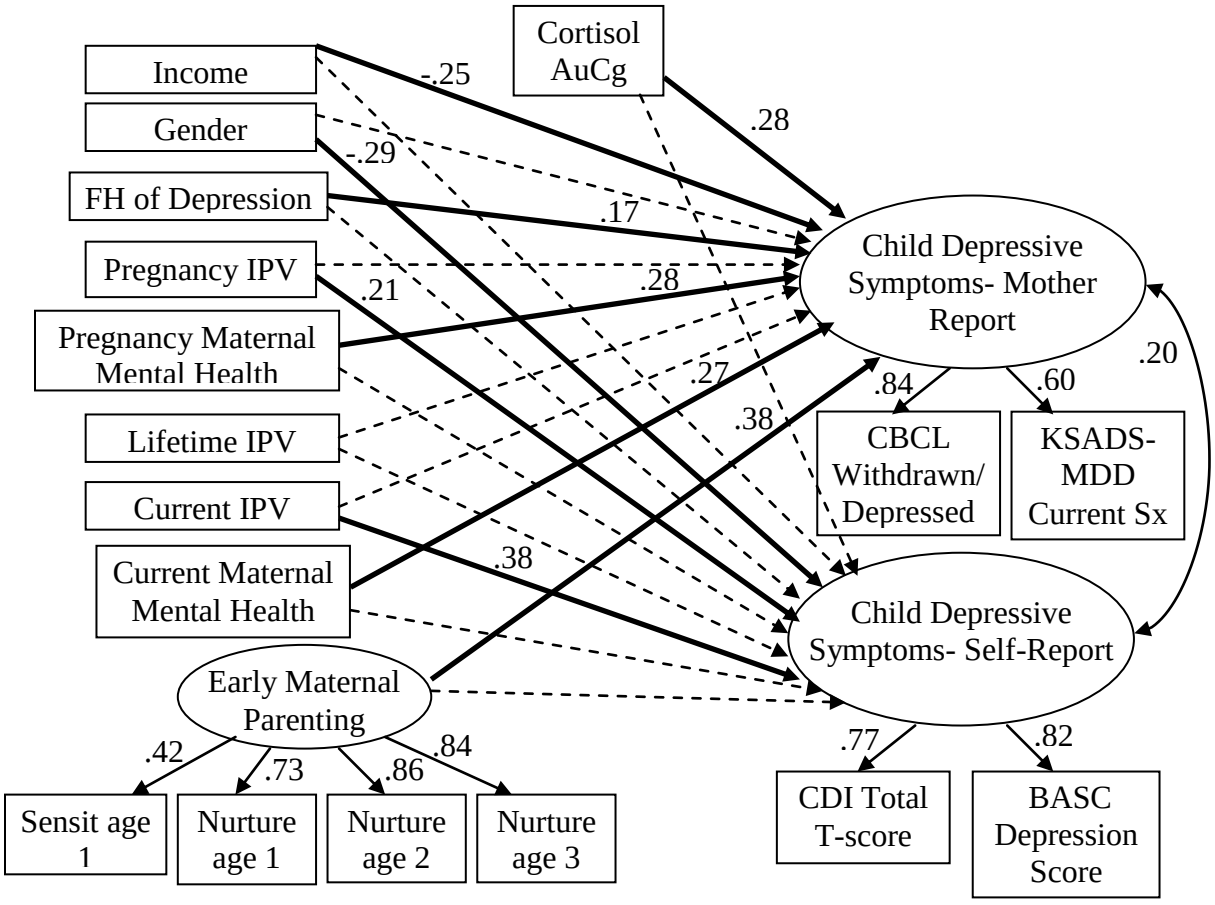


Figure 6

Hypothesis 4: Mediation Model with Cortisol Decrease, Pregnancy, and Postnatal Risk

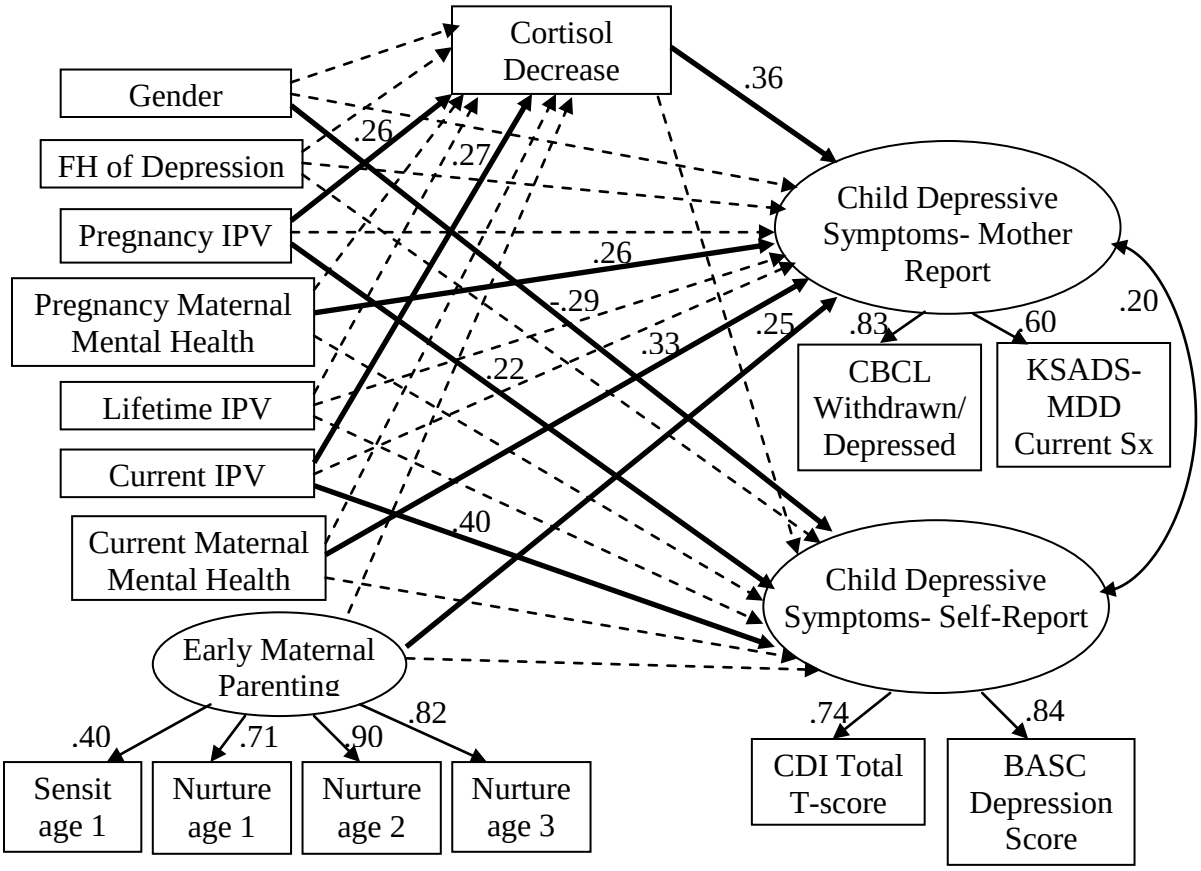


Figure 7

Hypothesis 4: Mediation Model with Cortisol AuCg, Pregnancy, and Postnatal Risk

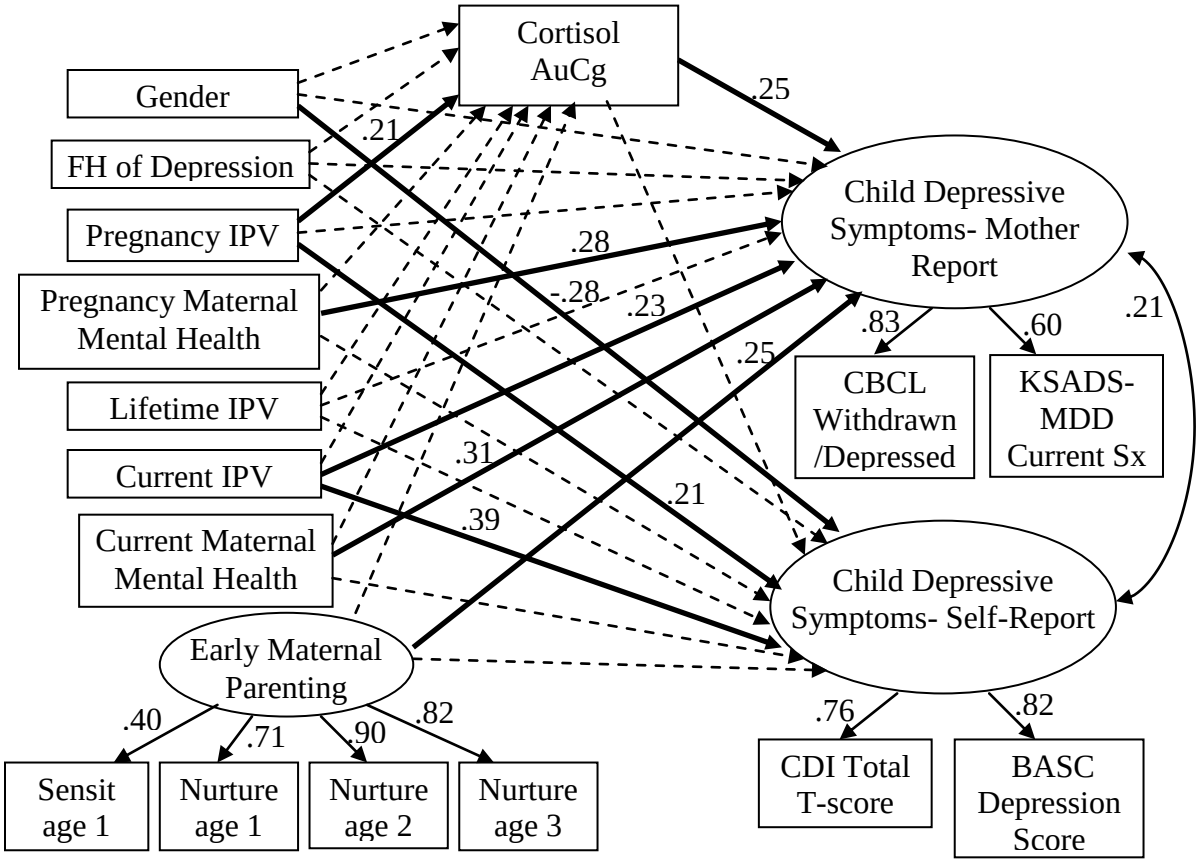


Figure 8

Hypothesis 5: Mediation Model for Self-Reported Child Depression via Cortisol Decrease, by Gender

Boys

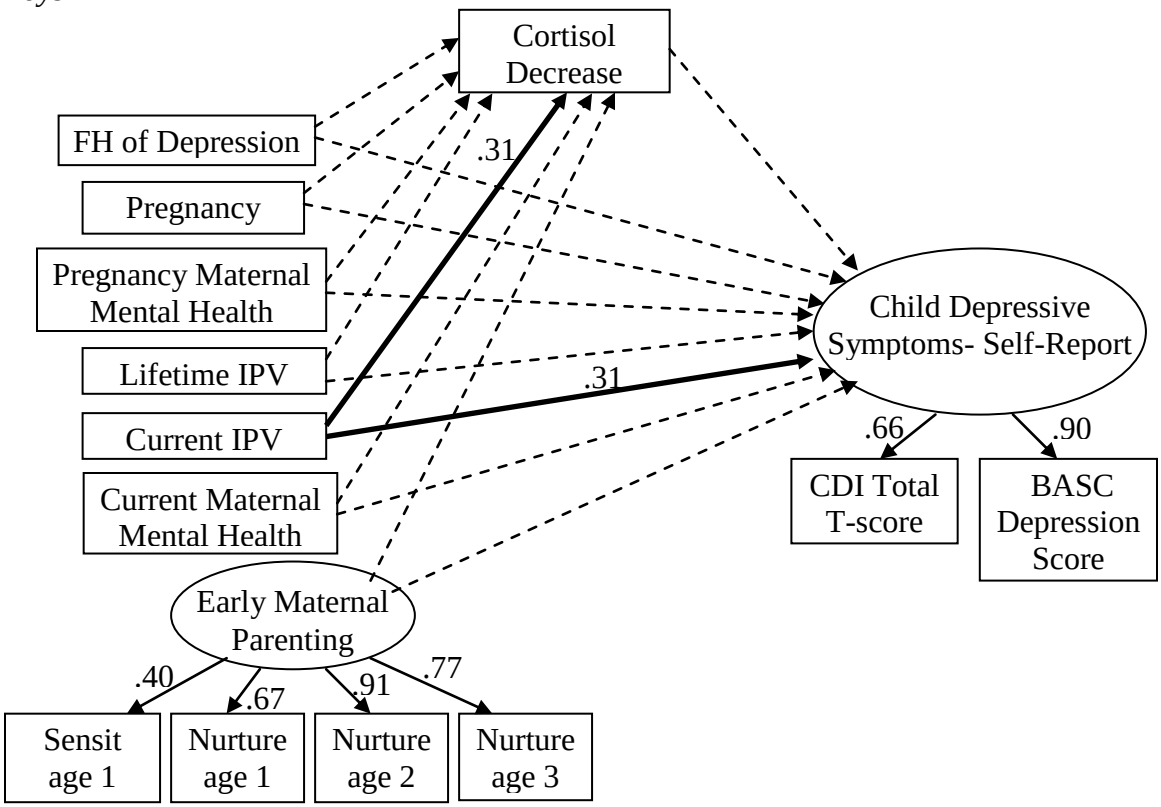


Figure 8 (cont'd)

Girls

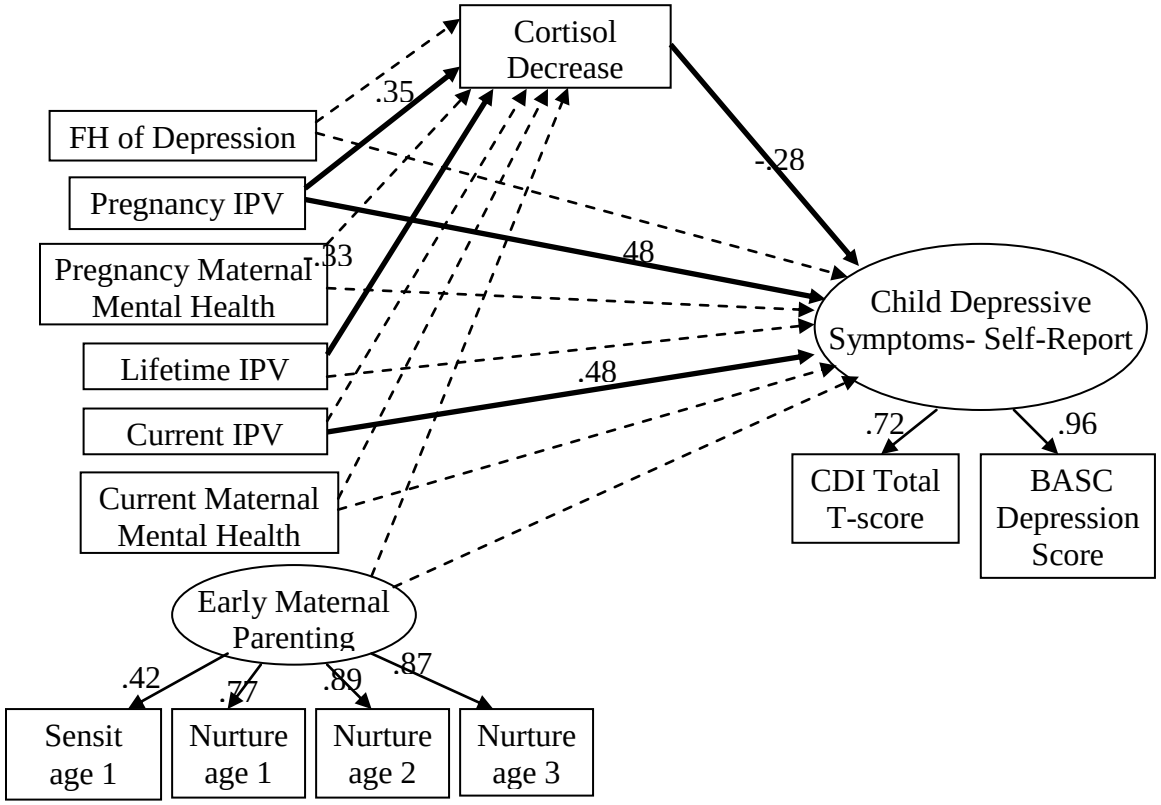


Figure 9
Hypothesis 5: Mediation Model for Self-Reported Child Depression via Cortisol AuCg, by Gender

Boys

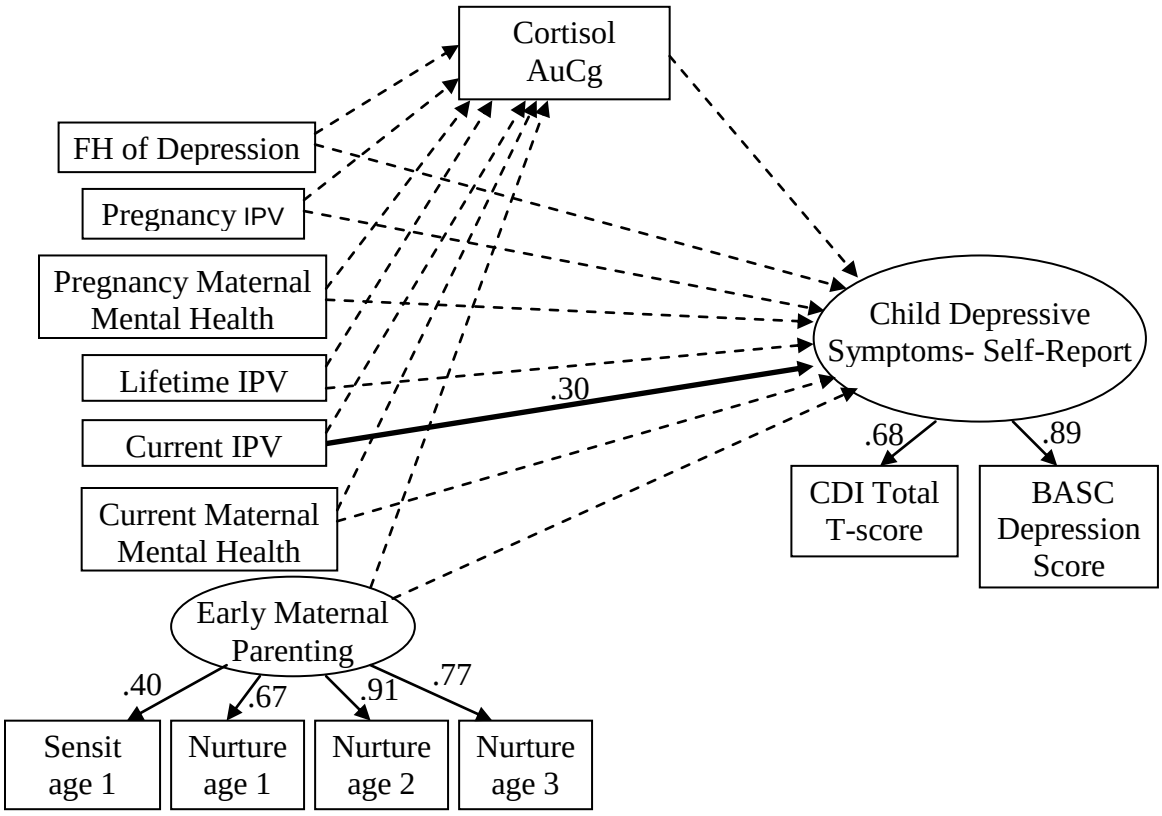


Figure 9 (cont'd)

Girls

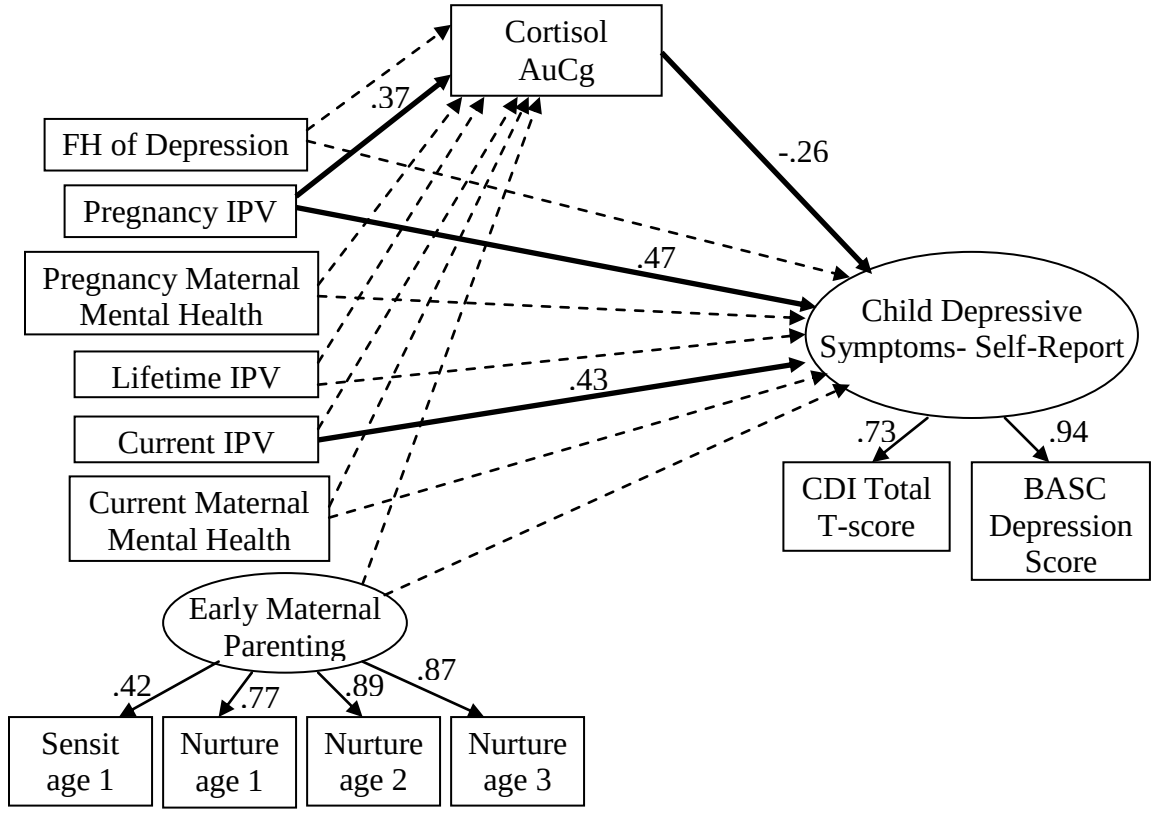


Figure 10
Hypothesis 5: Mediation Model for Self-Reported Child Depression via Cortisol Decrease, by Family History of Depression

Without MDD Family History

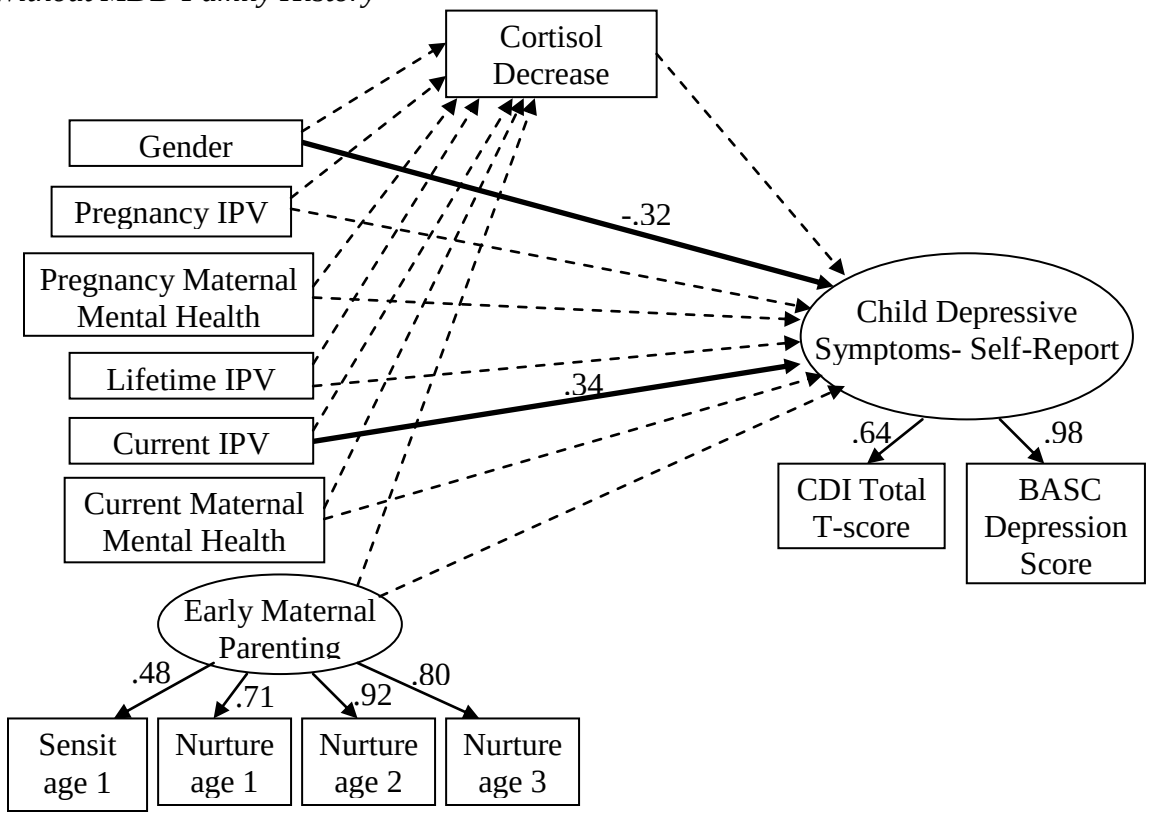


Figure 10 (cont'd)

With MDD Family History

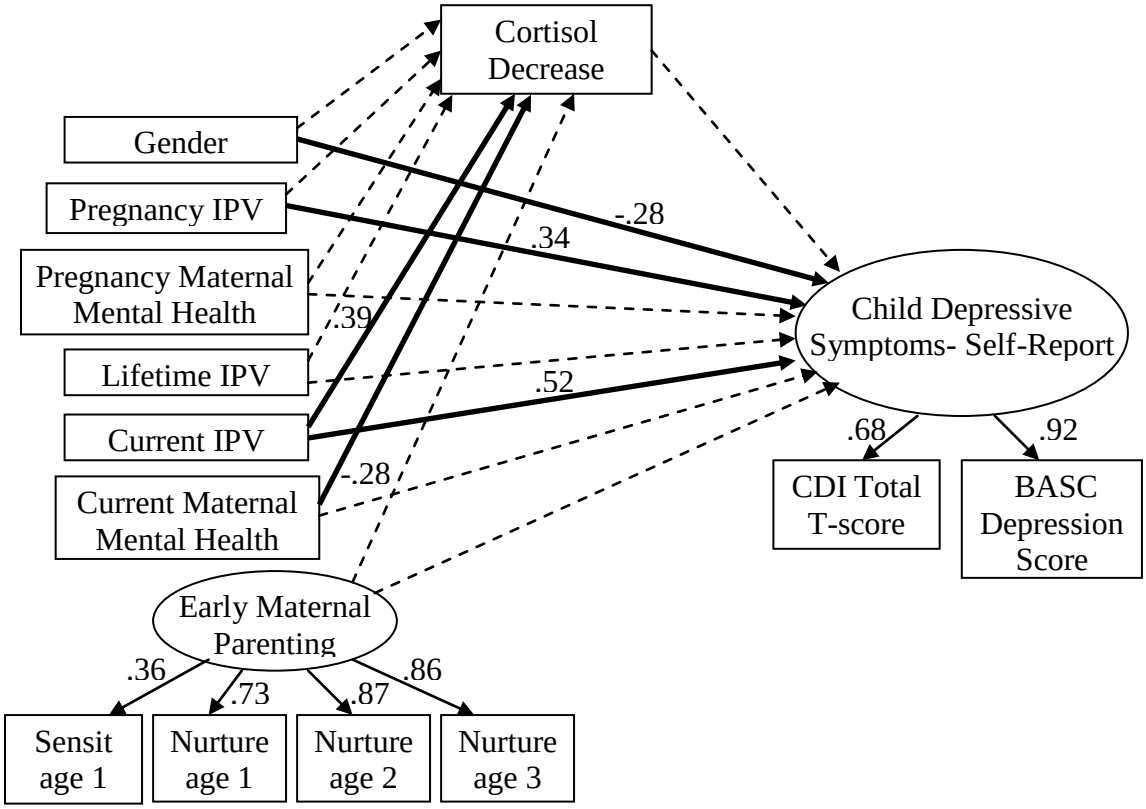


Figure 11
Hypothesis 5: Mediation Model for Self-Reported Child Depression via Cortisol AuCg, by Family History of Depression

Without MDD Family History

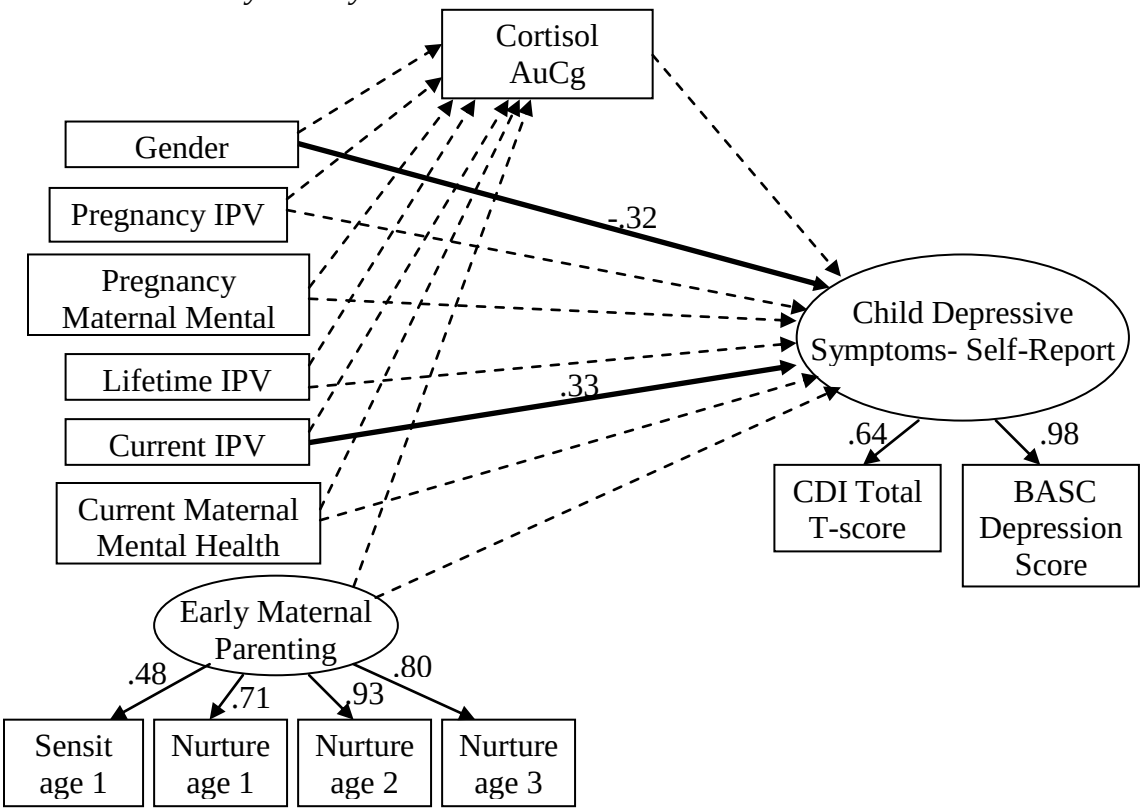
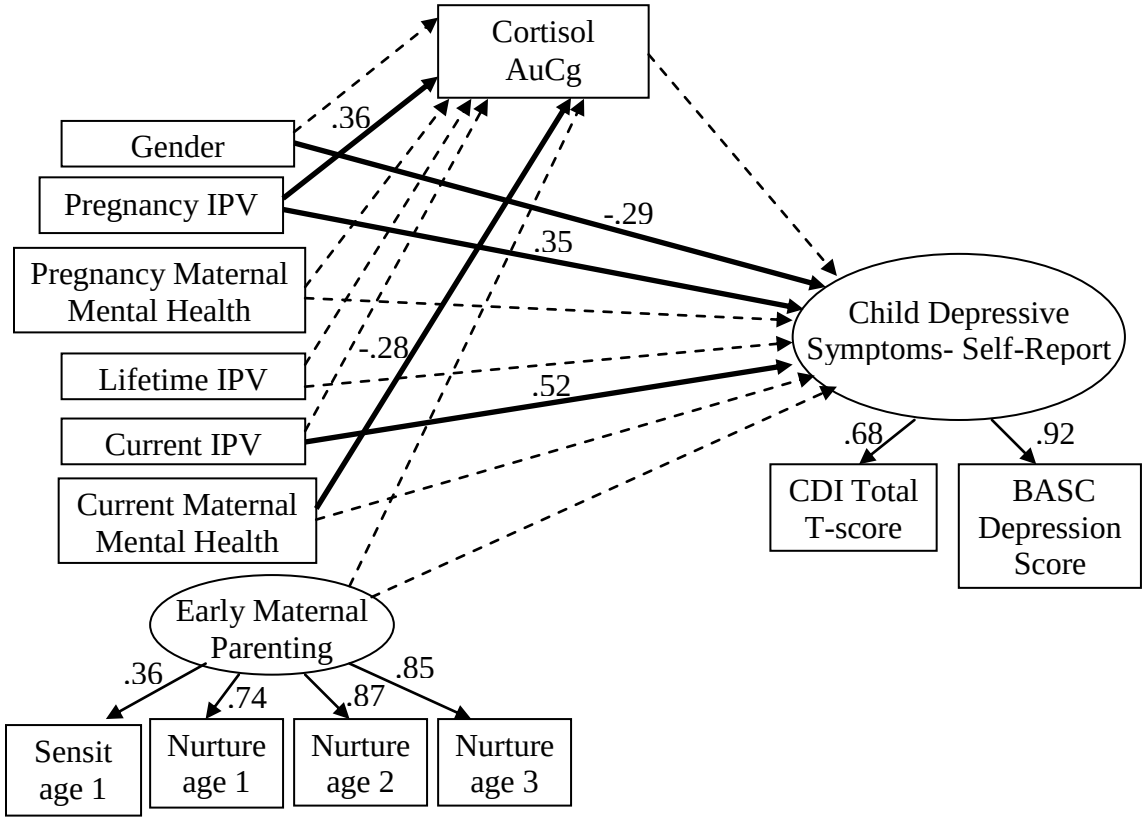


Figure 11 (cont'd)

With MDD Family History



REFERENCES

REFERENCES

Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile.* Burlington, VT: University of Vermont.

Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin, 101,* 213-232. doi: 10.1037/ 0033-2909.101.2.213

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for ASEBA School-Age Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.

Ackerman, B. P., Brown, E. D., & Izard, C. E. (2004). The relations between persistent poverty and contextual risk and children's behavior in elementary school. *Developmental Psychology, 40,* 367-377. doi: 10.1037/0012-1649.40.3.367

Ainsworth, M. D. S., Bell, S. M., & Stayton, D. J. (1971). Individual differences in strange-situation behavior of one-year-olds. In H. R. Schaffer (ed.), *The Origins of Human Social Relations*. London and New York: Academic Press. Pp. 17-58.

Allen, N. B., Lewinsohn, P. M., & Seeley, J. R. (1998). Prenatal and perinatal influences on risk for psychopathology in childhood and adolescence. *Development and Psychopathology, 10*, 513-529. doi: 10.1017/S0954579498001722

American Psychological Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR*. Washington, DC.

Angold, A., & Rutter, M. (1992). Effects of age and pubertal status on depression in a large clinical sample. *Development and Psychopathology, 4,* 5–28. doi: 10.1017/ S0954579400005538

Ashman, S. B., Dawson, G., Panagiotides, H., Yamada, E., & Wilkinson, C. W. (2002). Stress hormone levels of children of depressed mothers. *Development and Psychopathology, 14*, 333-349. doi: 10.1017/S0954579402002080

Austin, M. P., Hadzi-Pavlovic, D., Leader, L., Saint, K., & Parker, G. (2005). Maternal trait anxiety, depression and life event stress in pregnancy: relationships with infant temperament. *Early Human Development, 81,* 183-190. doi: 10.1016/j.earlhumdev.2005.07.005

Barbazanges, A., Piazza, P. V., LeMoal, M., & Maccari, S. (1996). Maternal glucocorticoid secretion mediates long-term effects of prenatal stress. *Journal of Neuroscience, 16*, 3943-3949. Retrieved from http://www.jneurosci.org/content/16/12/3943.full

Barker, D. J. P. (1998). In *utero* programming of chronic disease. *Clinical Science, 95,* 115-128. Retrieved from http://submit.clinsci.org/cs/095/0115/cs0950115.htm

Bateson, R., & Hinde, R. A. (1987). Developmental changes in sensitivity to experience. In H. M. Bornstein (Ed.), *Sensitive Periods in Development*, (pp. 19-34). Hillsdale, NJ: Erlbaum.

Bayer, J. K, Hiscock, H., Ukoumunne, O. C., Price, A, & Wake, M. (2008). Early childhood aetiology of mental health problems: A longitudinal population-based study. *Journal of Child Psychology and Psychiatry, 49,* 1166-1174. doi: 10.1111/j.1469-7610.2008.01943.x

Bayer, J. K., & Sanson, A. V. (2003). Preventing the development of emotional mental health problems from early childhood: Recent advances in the field. *The International Journal of Mental Health Promotion, 5*, 4-16. Retrieved from http://www.ijmhp.co.uk/2003.htm

Beardslee, W. R., Versage, E. M., & Gladstone, T. R. (1998). Children of affectively ill parents: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 1134-1141. doi: 10.1097/00004583-199811000-00012

Beauchaine, T. P., Neuhaus, E., Brenner, S. L., & Gatzke-Kopp, L. (2008). Ten good reasons to consider biological processes in prevention and intervention research. *Development and Psychopathology, 20*, 745-774. doi: 10.1017/S0954579408000369

Beck, A. T., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561-571.

Beck, A. T., Steer, R. A., & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review, 8*, 77-100. doi: 10.1016/0272-7358(88)90050-5

Bergman, K., Sarkar, P., O'Connor, T. G., Modi, N., & Glover, V. (2007). Maternal stress during pregnancy predicts cognitive ability and fearfulness in infancy. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*, 1454-1463. doi: 10.1097/chi.0b013e31814a62f6

Beydoun, H., & Saftlas, A. F. (2008). Physical and mental health outcomes of prenatal maternal stress in human and animal studies: A review of recent evidence. *Pediatric and Perinatal Epidemiology, 22,* 438-466. doi: 10.1111/j.1365-3016.2008.00951.x

Birmaher, B., Dahl, R. E., Perel, J., Williamson, D. E., Nelson, B., Stull, S., ... Ryan, N. D. (1996). Corticotropin-releasing hormone challenge in prepubertal major depression. *Biological Psychiatry, 39*, 267-277. doi: 10.1016/0006-3223(95)00177-8

Birmaher, B., Ryan, N. D., Williamson, D. E., Brent, D. A., Kaufman, J., Dahl, R. E., ... Nelson, B. (1996). Childhood and adolescent depression: A review of the past 10 years. *Journal*

of the American Academy of Child and Adolescent Psychiatry, 35, 1427-1439. doi: 10.1097/00004583-199611000-00011

Bogat, G. A., DeJonghe, E. S., Levendosky, A. A., Davidson, W. S., & von Eye, A. (2006). Trauma symptoms among infants who witness domestic violence toward their mothers. *Child Abuse & Neglect: The International Journal, 30,* 109-125. doi: 10.1016/j.chiabu.2005.09.002

Bogat, G. A., Levendosky, A. A., Theran, S., von Eye, A., & Davidson, W. S. (2003). Predicting the psychosocial effects of interpersonal partner violence (IPV): How much does a woman's history of IPV matter? *Journal of Interpersonal Violence,* 18, 121-142. doi: 10.1177/0886260503256657

Bogat, G. A., Levendosky, A. A., & von Eye, A. (2005). The future of research on intimate partner violence (IPV): person-oriented and variable-oriented perspectives. *American Journal of Community Psychology, 36*, 49-70. doi: 10.1007/s10464-005-6232-7

Bogoch, Y., Biala, Y. N., Linial, M., & Weinstock, M. (2007). Anxiety induced by prenatal stress is associated with suppression of hippocampal genes involved in synaptic function. *Journal of Neurochemistry, 101,* 1018-1030. doi: 10.1111/j.1471-4159.2006.04402.x

Bowlby, J. (1982). *Attachment and loss, Vol. 1: Attachment* (2nd ed.) New York: Basic Books.

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: I. An evolutionary-developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology, 17*, 271-301. doi: 10.1017/ S0954579405050145

Braaten, E. B., Biederman, J., DiMauro, A., Mick, E., Monuteaux, M. C., Muehl, K., & Faraone, S. V. (2001). Methodological complexities in the diagnosis of major depression in youth: an analysis of mother and youth self-reports. *Journal of Child and Adolescent Psychopharmacology, 11*, 395-407. doi: 10.1089/ 104454601317261573

Bradley, R. H., & Corwyn, R.F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53,* 371-399. doi: 10.1146/annurev.psych.53.100901.135233

Brennan, P. A., Pargas, R., Walker, E. F., Green, P., Newport, D. J., & Stowe, Z. (2008). Maternal depression and infant cortisol: influences of timing, comorbidity and treatment. *Journal of Child Psychology and Psychiatry, 49*, 1099-1107. doi: 10.1111/j.1469-7610.2008.01914.x

Briggs-Gowan, M.J., Carter, A.S., & Schwab-Stone, M. (1996). Discrepancies among mother, child, and teacher reports: Examining the contributions of maternal depression and anxiety. *Journal of Abnormal Child Psychology, 24*, 749–765. doi: 10.1007/BF01664738

Brouwers, E. P. M., van Baar, A. L, & Pop, V. J. M. (2001). Maternal anxiety during pregnancy and subsequent infant development. *Infant Behavior & Development, 24*, 95-106. doi: 10.1016/S0163-6383(01)00062-5

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136-159). Newbury Park: Sage Publications.

Brumariu, L. E., & Kerns, K. A. (2010). Mother-child attachment patterns and different types of anxiety symptoms: Is there specificity of relations? *Child Psychiatry and Human Development, 41,* 663-674. doi: 10.1007/s10578-010-0195-0

Burke, H. M., Davis, M. C., Otte, C., & Mohr, D. C. (2005). Depression and cortisol responses to psychological stress: A meta-analysis. *Psychoneuroendocrinonlogy, 30*, 846-856. doi: 10.1016/j.psyneuen.2005.02.010

Buske-Kirschbaum, A., Jobst, S., Wustman, A., Kirschbaum, C., Rauh, W., & Hellhammer, D. (1997) Attenuated free cortisol response to psychosocial stress in children with atopic dermatitis. *Psychosomatic Medicine, 59*, 419–426. Retrieved from http://www.psychosomaticmedicine.org

Calvete, E., Estevez, A., & Corral, S. (2007). Intimate partner violence and depressive symptoms in women: Cognitive schemas as moderators and mediators. *Behaviour Research and Therapy, 45*, 791-804. doi: 10.1016/j.brat.2006.07.006

Carlson, G. A., & Kashani, J. H. (1988). Phenomenology of major depression from childhood through adulthood. *American Journal of Psychiatry, 145,* 1222-1225. Retrieved from http://ajp.psychiatryonline.org/content/vol145/issue10/index.dtl

Caspi, A., Moffitt, T. E., Newman, D. L., & Silva, P. A. (1996). Behavioral observations at age 3 years predict adult psychiatric disorders: Longitudinal evidence from a birth cohort. *Archives of General Psychiatry,* 53, 1033-1039. Retrieved from http://archpsyc.ama-assn.org/cgi/content/summary/53/11/1033

Centers for Disease Control and Prevention. (2008*). Intimate Partner Violence Prevention. Scientific Information: Definitions*. Retrieved from http://www.cdc.gov/ncipc/dvp/IPV/ipv-definitions.htm

Charmandari, E., Tsigos, C., & Chrousos, G. (2005). Endocrinology of the stress response. *Annual Review of Physiology, 67*, 259-284. doi: 10.1146/ annurev.physiol.67.040403.120816

Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology, 8*, 597-600. doi: 10.1017/S0954579400007318

Cicchetti, D., & Rogosch, F. A. (2001). The impact of child maltreatment and psychopathology on neuroendocrine functioning. *Development and Psychopathology, 13*, 783-804. Retrieved from http://journals.cambridge.org/action/displayAbstract?fromPage =online&aid=92693

Cicchetti, D., Rogosch, F. A., Gunnar, M. R., & Toth, S. L. (2010). The differential impacts of early physical and sexual abuse and internalizing problems on daytime cortisol rhythm in school-aged children. *Child Development, 81,* 252-269. doi: 10.1111/j.1467-8624.2009.01393.x

Cicchetti, D., & Toth, S. L. (1998). The development of depression in children and adolescents. *American Psychologist, 53*, 221-241. doi: 10.1037/0003-066X.53.2.221

Clancy, B., Finlay, B. L., Darlington, R. B., & Anand, K. J. S. (2007). Extrapolating brain development from experimental species to humans. *Neurotoxicology, 28*, 931-937. doi: 10.1016/j.neuro.2007.01.014

Clinton, S., Miller, S., Watson, S. J., & Akil, A. (2008). Prenatal stress does not alter innate novelty-seeking behavioral traits, but differentially affects individual differences in neuroendocrine stress responsivity. *Psychoneuroendocrinonlogy, 33*, 162-177. doi: 10.1016/j.psyneuen.2007.10.012

Cloitre, M., Stolbach, B., Herman, J., van der Kolk, B., Pynoos, R., Wang, J., & Petkova, E. (2009). A developmental approach to complex PTSD: Childhood and adult cumulative trauma as predictors of symptom complexity. *Journal of Traumatic Stress, 22,* 399-408. doi: 10.1002/jts.20444

Cohen, J. A, Perel, J. M, DeBellis, M. D, Friedman, M. J, & Putnam, F. (2002). Treating traumatized children: Clinical implications of the psychobiology of posttraumatic stress disorder. *Trauma, Violence and Abuse, 3*, 91-108. doi: 10.1177/15248380020032001

Coker, A. L., Sanderson, M., & Dong, B. (2004). Partner violence during pregnancy and risk of adverse pregnancy outcomes. *Pediatric and Perinatal Epidemiology*, *18*, 260-269. doi: 10.1111/j.1365-3016.2004.00569.x

Connell, A.M., & Goodman, S.H. (2002). The association between psychopathology in fathers versus mothers and children's internalizing and externalizing behavior problems: A meta-analysis. *Psychological Bulletin, 128,* 746-773. doi: 10.1037/0033-2909.128.5.746

Costello, E. J., Egger, H. L, & Angold, A. (2005). 10-year research update review: The epidemiology of child and adolescent psychiatric disorders. I. The public health burden. *Journal of the American Academy of Child and Adolescent Psychiatry*, *44*, 972-986. doi: 10.1097/01.chi.0000172552.41596.6f

Cushing, B. S., & Kramer, K. M. (2005). Mechanisms underlying epigenetic effects of early social experience: The role of neuropeptides and steroids. *Neuroscience & Biobehavioral Reviews, 29,* 1089-1105. doi: 10.1016/j.neubiorev.2005.04.001

Dansky, B. S., Byrne, C. A., & Brady, K. T. (1999). Intimate violence and post-traumatic stress disorder among individuals with cocaine dependence. *American Journal of Drug and Alcohol Abuse, 25,* 257-268. doi: 10.1081/ADA-100101859

Davies, P. T., Sturge-Apple, M. L., Cicchetti, D., & Cummings, M .E. (2008). The role of child adrenocortical functioning in pathways between interparental conflict and child maladjustment. *Developmental Psychology, 43,* 918-930. doi: 10.1111/j.1467-8624.2008.01219.x

Davis, E. P., Glynn, L. M., Dunkel Schetter, C., Hobel, C., Chicz-Demet, A., & Sandman, C. A. (2007). Prenatal exposure to maternal depression and cortisol influences infant temperament. *Journal of the American Academy of Child and Adolescent Psychiatry, 46,* 737-746. doi: 10.1097/chi.0b013e318047b775

Dayton, C. J., Levendosky, A. A., Davidson, W. S., & Bogat, G. A. (2010). The child as held in the mind of the mother: The influence of prenatal maternal representations on parenting behaviors. *Infant Mental Health Journal, 31,* 220-241. doi: 10.1002/imhj.20253

DeBellis, M. D., Dahl, R. E., Perel, J. M., Birmaher, B., AlShabbout, M., Williamson, D. E., ... Ryan, N. D. (1996). Nocturnal ACTH, cortisol, growth hormone, and prolactin secretion in prepubertal depression. *Journal of the American Academy of Child and Adolescent Psychiatry, 35,* 1130-1138. doi: 10.1097/00004583-199609000-00010

De Bruijn, T. C. E., van Bakel, H. J. A., Wijnen, H., Pop, V. J. M., & van Baar, A. L. (2009). Prenatal maternal emotional complaints are associated with cortisol responses in toddler and preschool aged girls. *Developmental Psychobiology*, *51*(7), 553-563. doi: 10.1002/dev.20393

DeJonghe, E. S., Bogat, G. A., Levendosky, A. A., & von Eye, A. (2008). Women survivors of intimate partner violence and post-traumatic stress disorder: Prediction and prevention. *Journal of Postgraduate Medicine, 54,* 294-300. Retrieved from http://www.jpgmonline.com/text.asp?2008/54/4/294/41435

DeJonghe, E. S., Bogat, G. A., Levendosky, A. A., von Eye, A., & Davidson, W. S. (2005). Infant exposure to domestic violence predicts heightened sensitivity to adult verbal conflict. *Infant Mental Health Journal,* 26, 268-281. doi: 10.1002/imhj.20048

De Los Reyes, A., & Kazdin, A. (2005). Informant discrepancies in the assessment of childhood psychopathology: A critical review, theoretical framework, and recommendations for further study. *Psychological Bulletin, 131,* 483-509. doi: 10.1037/0033-2909.131.4.483

Derogatis, L. R., & Melisaratos, N. (1983). The Brief Symptom Inventory: An introductory report. *Psychological Medicine, 13,* 595-605. doi: 10.1017/ S0033291700048017

de Weerth, C., van Hees, Y., & Buitelaar, J. K. (2003). Prenatal maternal cortisol levels and infant behavior during the first 5 months. *Early Human Development, 74,* 139-151. doi: 10.1016/S0378-3782(03)00088-4

De Wolff, M. S., & van IJzendoorn, M. H. (1997). Sensitivity and attachment: A meta-analysis on parental antecedents of infant attachment. *Child Development, 68,* 571-591. doi: 10.2307/1132107

Diego, M. A., Jones, N. A., Field, T., Hernandez-Reif, M., Schanberg, S., Kuhn, C., & Gonzalez-Garcia, A. (2006). Maternal psychological distress, prenatal cortisol, and fetal weight. *Psychosomatic Medicine, 68,* 747-753. doi: 10.1097/ 01.psy.0000238212.21598.7b

Dougherty, L. R., Klein, D. N., Olino, T. M., Dyson, M., & Rose, S. (2009). Increased waking salivary cortisol and depression risk in preschoolers: The role of maternal history of melancholic depression and early child temperament. *Journal of Child Psychology and Psychiatry, 50,* 1495-1503. doi:10.1111/j.1469-7610.2009.02116.x

Downey, G., & Coyne, J. C. (1990). Children of depressed parents: An integrative review. *Psychological Bulletin, 108,* 50-76. doi: 10.1037/0033-2909.108.1.50

Eaves, L. J., Silberg, J. L., Meyer, J. M., Maes, H. H., Simonoff, E., Pickles, A., … Hewitt, J. K. (1997). Genetics and developmental psychopathology 2. The main effects of genes and environment on behavioral problems in the Virginia twin study of adolescent behavioral development. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 38,* 965-980. doi: 10.1111/j.1469-7610.1997.tb01614.x

Eby, K. K. (2004). Exploring the Stressors of Low-Income Women With Abusive Partners: Understanding Their Needs and Developing Effective Community Responses. *Journal of Family Violence, 19,* 221-232. doi: 10.1023/ B:JOFV.0000032632.59865.8e

Edelbrock, C. S., Costello, A. J., Dulcan, M., Conover, N. C., & Kala, R. (1986). Parent-child agreement on child psychiatric symptoms assessed via structured interview. *Journal of Child Psychology and Psychiatry, 27,* 181–190. doi: 10.1111/j.1469-7610.1986.tb02329.x

Edleson, J.L. (1999). Children's witnessing of adult domestic violence. *Journal of Interpersonal Violence, 14,* 839-870. doi: 10.1177/088626099014008004

Eley, T. C., Liang, H., Plomin, R., Sham, P., Sterne, A., Williamson, R., & Purcell, S. (2004). Parental vulnerability, family environment and their interactions as predictors of depressive symptoms in adolescents . *Journal of the American Academy of Child and Adolescent Psychiatry, 43,* 298-306. doi: 10.1097/ 00004583-200403000-00011

Eley, T. C., & Stevenson, J. (2000). Specific life events and chronic experiences differentially associated with depression and anxiety in young twins. *Journal of Abnormal Child Psychology, 28,* 383-394. doi: 0.1023/A:1005173127117

Ellis, B. J., Jackson, J. J., & Boyce, W. T. (2006). The stress response systems: Universality and adaptive individual differences. *Developmental Review, 26,* 175-212. doi: 10.1016/j.dr.2006.02.004

Entringer, S., Kumsta, R., Hellharnmer, D. H., Wadhwa, P. D., & Wust, S. (2009). Prenatal exposure to maternal psychosocial stress and HPA axis regulation in young adults. *Hormones and Behavior, 55,* 292-298. doi: 10.1016 /j.yhbeh.2008.11.006

Erickson, K., Drevets, W., & Schulkin, J. (2003). Glucocorticoid regulation of diverse cognitive functions in normal and pathological emotional states. Neuroscience and Biobehavioral Reviews, 27, 233-246. doi: 10.1016/S0149-7634(03)00033-2

Evans, G. W. (2004). The Environment of Childhood Poverty. *American Psychologist, 59,* 77-92. doi: 10.1037/0003-066X.59.2.77

Evans, S. E., Davies, C., & DiLillo, D. (2008). Exposure to domestic violence: A meta-analysis of child and adolescent outcomes. *Aggression and Violent Behavior, 13,* 131-140. doi: 10.1016/j.avb.2008.02.005

Essex, M. J., Klein, M. H., Cho, E., & Kalin, N. H. (2002). Maternal stress beginning in infancy may sensitize children to later stress exposure: Effects on cortisol and behavior. *Biological Psychiatry, 52,* 776-784. doi: 10.1016/S0006-3223(02)01553-6

Fantuzzo, J., Boruch, R., Beriama, A., Atkins, M., & Marcus, S. (1997). Domestic violence and children: Prevalence and risk in five major US cities. *Journal of the American Academy of Child and Adolescent Psychiatry, 36,* 116-122. doi: 10.1097/00004583-199701000-00025

Fekedulegn, D. B., Andrew, M. E., Burchfiel, C. M., Violanti, J. M., Hartley, T. A., Charles, L. E., & Miller, D. B. (2007). Area under the curve and other summary indicators of repeated waking cortisol measurements. *Psychosomatic Medicine, 69,* 651-659. doi: 10.1097/PSY.0b013e31814c405c

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., & Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child and Adolescent Psychiatry, 48,* 919-927. doi: 10.1097/CHI.0b013e3181b21651

Field, T., Diego, M., Hernandez-Reif, M., Vera, Y., Gil, K., & Schanberg, S., … Bendell, D. (2004) Prenatal maternal biochemistry predicts neonatal biochemistry. *International Journal of Neuroscience, 114,* 933-945. doi: 10.1080/ 00207450490461305

Field, T., Hernandez-Reif, M., Diego, M., Figueiredo, B., & Schanberg, S. (2006). Prenatal cortisol, prematurity and low birthweight. *Infant Behavior and Development, 29,* 268-275. doi: 10.1016/j.infbeh.2005.12.010

Finkelhor, D., & Kendall-Tackett, K. A. (1997). A developmental perspective on the childhood impact of crime, abuse, and violent victimization. In D. Cicchetti & S. L. Toth (Eds.), *Developmental perspectives on trauma: Theory, research, and intervention* (pp. 1-32). Rochester, NY: University of Rochester Press.

Fish, E. W., Shahrokh, D., Bagot, R., Caldji, C., Bredy, T., Szyf, M., & Meaney, M. J. (2004). Epigenetic programming of stress responses through variations in maternal care. *Annals of the New York Academy of Science, 1036,* 167-80. doi: 10.1196/annals.1330.011

Fox, R. A. (1994). *Parent Behavior Checklist*. Brandon, VM: Clinical Psychology Publishing Company.

Frieze, I. H., Knoble, J., Washburn, C., & Zomnir, G. (1980). Types of battered women. Paper presented at the Association for Women in Psychology. Santa Monica, CA.

Fugate, M., Landis, L., Riordan, K., Naureckas, S., & Engel, B. (2005). Barriers to domestic violence help seeking: Implications for intervention. Violence Against Women, 11, 290–310. doi: 10.1177/1077801204271959

Garai, E. P., Forehand, R., Colletti, C. J. M., Reeslund, K., Potts, J., & Compas, B. E. (2009). The relation of maternal sensitivity to children's internalizing and externalizing problems within the context of maternal depressive symptoms. *Behavior Modification, 33*, 559-582. doi: 10.1177/0145445509342581

Gazmararian, J. A., Lazorick, S., Spitz, A. M., Ballard, T. J., Saltzman, L. E., & Marks, J. S. (1996). Prevalence of violence against pregnant women. *JAMA-Journal of the American Medical Association, 275,* 1915-1920. doi: 10.1001/ jama.1996.03530480057041

Gitau, R., Cameron, A., Fisk, N. M., & Glover, V. (1998). Fetal exposure to maternal cortisol. *Lancet, 352,* 707-708. doi: 10.1016/S0140-6736(05)60824-0

Gladstone, G. L., & Parker, G. B. (2006). Is behavioral inhibition a risk factor for depression? *Journal of Affective Disorders, 95,* 85-94. doi: 10.1016/j.jad.2006. 04.015

Glover, V., Bergman, K., Sarkar, P., & O'Connor, T. G. (2009) Association between maternal and amniotic fluid cortisol is moderated by maternal anxiety. *Psychoneuroendocrinology, 34,* 430-435. doi: 10.1016/j.psyneuen.2008.10.005

Glover, V., O'Connor, T. G., & O'Donnell, K. (2010). Prenatal stress and the programming of the HPA axis. *Neuroscience and Biobehavioral Reviews, 35,* 17-22. doi: 10.1016/j.neubiorev.2009.11.008

Golding, J. M. (1999). Intimate partner violence as a risk factor for mental disorders: A meta-analysis. *Journal of Family Violence, 14,* 99-132. doi: 10.1023/ A:1022079418229

Goodman, S.H., & Gotlib, I.H. (1999). Risk for psychopathology in the children of depressed parents: A developmental approach to the understanding of mechanisms. *Psychological Review, 106,* 458-490. doi: 10.1037/0033-295X.106.3.458

Goodyer, I. M. (2008). Emanuel Miller Lecture: Early onset depressions - meanings, mechanisms and processes. *Journal of Child Psychology and Psychiatry, 49,* 1239-1256. doi: 10.1111/j.1469-7610.2008.01964.x

Goodyer, I. M., Herbert, J., Altham, P. M. E., Pearson, J., Secher, S. M., & Shiers, H. M. (1996). Adrenal secretion during major depression in 8- to 16-year-olds: Altered diurnal rhythms in salivary cortisol and dehydroepiandrosterone (DHEA) at presentation. *Psychological Medicine, 26,* 245-256. doi: 0.1017/S0033291700034644

Goodyer, I. M., Park, R. J., & Herbert, J. (2001). Psychosocial and endocrine features of chronic first-episode major depression in 8-16 year olds. *Biological Psychiatry, 50,* 351-357. doi: 10.1016/S0006-3223(01)01120-9

Gotlib, I. H., Lewinsohn, P. M., & Seeley, J. R. (1995). Symptoms versus a diagnosis of depression: Differences in psychosocial functioning. *Journal of Consulting and Clinical Psychology, 63,* 90-100. doi: 10.1097/00004583-199509000-00021

Graham-Bermann, S. A., Gruber, G., Girz, L., & Howell, K. H. (2009). Factors discriminating among profiles of resilient coping and psychopathology in children exposed to domestic violence. *Child Abuse & Neglect, 33,* 648-660. doi: 10.1016/j.chiabu.2009.01.002

Grant, K. A., McMahon, C., Austin, M. P., Reilly, N., Leader, L., & Ali, S. (2009). Maternal prenatal anxiety, postnatal caregiving and infants' cortisol responses to the Still-Face Procedure. *Developmental Psychobiology, 51,* 625-637. doi: 10.1002/dev.20397

Griffin, M. G., Resick, P. A., & Yehuda, R. (2005). Enhanced cortisol suppression following dexamethasone administration in domestic violence survivors. *American Journal of Psychiatry, 162,* 1192-1199. doi: 10.1176/ appi.ajp.162.6.1192

Grych, J. H., Jouriles, E. N., Swank, P. R., McDonald, R., & Norwood, W. D. (2000). Patterns of adjustment among children of battered women. *Journal of Consulting and Clinical Psychology, 68,* 84-94. doi: 10.1037/0022-006X.68.1.84

Gunnar, M. R., & Donzella, B. (2002). Social regulation of the cortisol levels in early human development. *Psychoneuroendocrinology, 27,* 199-220. doi: 10.1016/S0306-4530(01)00045-2

Gunnar, M. R., & Quevedo, K. (2007). The neurobiology of stress and development. *Annual Review of Psychology, 58,* 145-173. doi: 10.1146/ annurev.psych.58.110405.085605

Gunnar, M. R., Sebanc, A. M., Tout, K., Donzella, B., & van Dulmen, M. M. H. (2003). Peer rejection, temperament, and cortisol activity in preschoolers. *Developmental Psychobiology, 43,* 346-368. doi: 10.1002/dev.10144

Gutteling, B. M., De Weerth, C., & Buitelaar, J. K. (2005). Prenatal stress and children's cortisol reaction to the first day of school. *Psychoneuroendocrinology, 30,* 541-549. doi: 10.1016/j.psyneuen.2005.01.002

Gutteling, B. M., de Weerth, C., Willemsen-Swinkels, S. H. N., Huizink, A. C., Mulder, E. J. H., Visser, G. H. A., & Buitelaar, J. K. (2005). The effects of prenatal stress on temperament and problem behavior of 27-month-old toddlers. *European Child & Adolescent Psychiatry, 14,* 41-51. doi: 10.1007/s00787-005-0435-1

Hammen, C., & Rudolph, K. (2003). Childhood depression. In E. J. Mash & R. A. Barkley (Eds.), *Child Psychopathology, 2nd Edition* (pp. 233-278). New York: Guilford Press.

Hankin, B. L., Badanes, L. S., Abuela, Watamura, S. E. (2010). Hypothalamic pituitary adrenal axis dysregulation in dysphoric children and adolescents: Cortisol reactivity to psychosocial stress from preschool through middle adolescence. *Biological Psychiatry, 68,* 484-490. 10.1016/j.biopsych.2010.04.004

Herbert, J., Goodyer, I. M., Altham, P. M. E., Pearson, J., Secher, S. M., & Shiers, H. M. (1996). Adrenal secretion and major depression in 8- to 16-year-olds .2. Influence of co-morbidity at presentation. *Psychological Medicine, 26,* 257-263. doi: 10.1017/S0033291700034656

Herbert, J., Goodyer, I. M., Grossman, A. B., Hastings, M. H., de Kloet, E. R., & Lightman, S. L. (2006). Do corticosteroids damage the brain? *Journal of Neuroendocrinology, 18,* 393-411. doi: 10.1111/j.1365-2826.2006.01429.x

Hodges, K., Gordon, Y., & Lennon, M. P. (1990). Parent-child agreement on symptoms assessed via a clinical research interview for children: the Child Assessment Schedule (CAS). *Journal of Child Psychology and Psychiatry, 31,* 427-36. doi: 10.1111/j.1469-7610.1990.tb01579.x

Hosmer, D., & Lemeshow, S. (1989). *Applied Logistic Regression*. New York: John Wiley & Sons.

Huang, C-C., Wang, L. R., Warrener, C. (2010). Effects of domestic violence on behavior problems of preschool-aged children: Do maternal mental health and parenting mediate the effects? *Children and Youth Services Review, 32,* 1317-1323. doi: 10.1016/j.childyouth.2010.04.024

Huizink, A. C., Bartels, M., Rose, R. J., Pulkkinen, L., Eriksson, C. J. P., & Kaprio, J. (2008). Chernobyl exposure as stressor during pregnancy and hormone levels in adolescent offspring. *Journal of Epidemiology and Community Health, 62,* 1-6. doi: 10.1136/jech.2007.060350

Huizink, A. C., de Medina, P. G. R., Mulder, E. J. H., Visser, G. H. A., & Buitelaar, J. K. (2002). Psychological measures of prenatal stress as predictors of infant temperament. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*, 1078-1085. doi: 10.1097/00004583-200209000-00008

Huizink, A. C., Mulder, E. J., & Buitelaar, J. K. (2004). Prenatal stress and risk for psychopathology early or later in life: Specific effects or induction of general susceptibility? *Psychological Bulletin, 130*, 115-142. doi: 10.1037/0033-2909.130.1.115

Huot, R. L., Brennan, P. A., Stowe, Z. N., Plotsky, P. M. & Walker, E. F. (2004). Negative affect in offspring of depressed mothers is predicted by infant cortisol levels at 6 months and maternal depression during pregnancy, but not postpartum. *Annals of the New York Academy of Sciences, 1032,* 234–236. doi: 10.1196/annals.1314.028

Huth-Bocks, A.C., Levendosky, A.A., & Bogat, G.A. (2002). The effects of domestic violence during pregnancy on maternal and infant health. *Violence and Victims, 17*, 169-185. doi: 10.1891/vivi.17.2.169.33647

Huth-Bocks, A.C., Levendosky, A. A., Bogat , G. A., & von Eye, A. (2004). The impact of maternal characteristics and contextual variables on infant-mother attachment. *Child Development*, 75, 480-496. doi: 10.1111/j.1467-8624.2004.00688.x

Huth-Bocks, A. C., Levendosky, A. A., & Semel, M. A. (2001). The direct and indirect effects of domestic violence on young children's intellectual functioning. *Journal of Family Violence, 16*, 269-290. doi: 10.1023/A:1011138332712

Huth-Bocks, A. C., Levendosky, A. A., Theran, S. A., & Bogat, G. A. (2004). The impact of domestic violence on mothers' prenatal representations of their infants. *Infant Mental Health Journal*, 25, 79-98. doi: 10.1002/imhj.10094

Inslicht, S. S., Marmar, C. R., Neylan, T. C., Metzler, T. J., Hart, S. L., Otte, C., ... Baum, A. (2006). Increased cortisol in women with intimate partner violence-related posttraumatic stress disorder. *Psychoneuroendocrinology, 31,* 825-838. doi: 10.1016/j.psyneuen.2006.03.007

Jacobvitz, D., Hazen, N., Curran, M., & Hitchens, K. (2004). Observations of early triadic family interactions: Boundary disturbances in the family predict depressive, anxious, and ADHD symptoms in middle childhood. *Development and Psychopathology, 16,* 577-592. doi: 10.1017/S0954579404004675

Jarvis, K. L., Gordon, E. E., & Novaco, R. W. (2005). Psychological distress of children and mothers in domestic violence emergency shelters. *Journal of Family Violence, 20,* 389-402. doi: 10.1007/s10896-005-7800-1

Jennings, K. D., Sandberg, I., Kelley, S. A., Valdes, L., Yaggi, K., Abrew, A., & Macey-Kalcevic, M. (2008). Understanding of self and maternal warmth predict later self-regulation in toddlers. *The International Journal of Behavioral Development, 32,* 108-118. doi: 10.1177/0165025407087209

Jouriles, E. N., Spiller, L. C., Stephens, N., McDonald, R., and Swank, P. (2000). Variability in adjustment of children of battered women: The role of child appraisals of interparent conflict. *Cognitive Therapy and Research, 24,* 233-249. doi: 10.1023/A:1005402310180

Kapcala, L. P., Chautard, T. and Eskay, R. L. (1995). The protective role of the Hypothalamic-Pituitary-Adrenal Axis against lethality produced by immune, infectious, and inflammatory stress. *Annals of the New York Academy of Sciences, 771,* 419–437. doi: 10.1111/j.1749-6632.1995.tb44699.x

Kaplan, H. B. (1996). Perspectives on psychosocial stress. In H. B. Kaplan (Ed.), *Psychosocial Stress: Perspectives in Structure, Theory, Life-Course, and Methods* (pp. 3-23). San Diego CA: Academic Press.

Kaplan, L. A., Evans, L., & Monk, C. (2008). Effects of mothers' prenatal psychiatric status and postnatal caregiving on infant biobehavioral regulation: Can prenatal programming be modified? *Early Human Development, 84,* 249-256. doi: 10.1016/j.earlhumdev.2007.06.004

Kaslow, N. J., Heron, S., Roberts, D. K., Thompson, M., Guessous, O., & Jones, C. (2004). Family and community factors that predict internalizing and externalizing symptoms in low income, African American children: A preliminary report. *Annals of the New York Academy of Sciences, 1008,* 55-68. doi: 10.1196/annals.1301.007

Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., … Ryan, N. (1997). Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL): Initial Reliability and Validity Data. *Journal of the American Academy of Child and Adolescent Psychiatry, 36,* 980-988. doi: 10.1097/00004583-199707000-00021

Kaufman, J., Birmaher, B., Brent, D., Rao, U., & Ryan, N. (1996), *Kiddie–SADS–Present and Lifetime Version*. (K–SADS–PL). Pittsburgh: University of Pittsburgh School Of Medicine.

Kaufman, J., Yang, B. Z., Douglas-Palumberi, H., Grasso, D., Lipschitz, D., Houshyar, S., … Gelertner, J.(2006). BDNF-5-HTTLPR gene interactions and environmental modifiers of depression in children. *Biological Psychiatry, 5,* 673-680. doi: 10.1016/j.biopsych.2005.10.026

Kendler, K. S., Gardner, C. O., & Lichtenstein, P. (2008). A developmental twin study of symptoms of anxiety and depression: Evidence for genetic innovation and attenuation. *Psychological Medicine, 30*, 1-9. doi: 10.1017/ S003329170800384X

Kiss, E., Gentzler, A. M., George, C., Kapornai, K., Tamas, Z., Kovacs, M., & Vetro, A. (2007). Factors influencing mother-child reports of depressive symptoms and agreement among clinically referred depressed youngsters in Hungary. *Journal of Affective Disorders, 100*, 143-151. doi: 10.1016/j.jad.2006.10.008

Kitzmann, K. M., Gaylord, N. K., Holt, A. R., & Kenny, E. D. (2003). Child witnesses to domestic violence: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 71*, 339-352. doi: 10.1037/0022-006X.71.2.339

Kliewer, W., Cunningham, J. N., Diehl, R., Parrish, K. A, Walker, J. M., Atiyeh, C., … Mejia, R. (2004). Violence exposure and adjustment in inner-city youth: Child and caregiver emotion regulation skill, caregiver-child relationship quality, and neighborhood cohesion as protective factors. *Journal of Clinical Child and Adolescent Psychology, 33*, 477-487. doi: 10.1207/s15374424jccp3303_5

Kline, R.B. (2005). *Principles and practice of structural equation modeling* (Second Ed.). New York: Guilford Press.

Kovacs, M. (1996). Presentation and course of major depressive disorder during childhood and later years of the life span, *Journal of the American Academy of Child and Adolescent Psychiatry*, 35, 705–715. Doi: 10.1097/00004583-199606000-00010

Kovacs, M. (1992). *Children's Depression Inventory Manual*. New York: Multi-Health Systems.

Kovacs, M., Devlin, B., Pollock, M., Richards, C., & Mukerji, P. (1997). A controlled family history study of childhood-onset depressive disorder. *Archives of General Psychiatry, 54*, 613-623. Retrieved from http://archpsyc.ama-assn.org/content/vol54/issue7/index.dtl

Kovacs, M., Feinberg, T. L., Crousenovak, M. A., Paulauskas, S. L., & Finkelstein, R. (1984). Depressive disorders in childhood: 1. A longitudinal prospective study of

characteristics and recovery. *Archives of General Psychiatry, 42,* 229-237. Retrieved from http://archpsyc.ama-assn.org/cgi/content/abstract/41/3/229

Laffaye, C., Kennedy, C., & Stein, M. B. (2003). Posttraumatic stress disorder and health-related quality of life in female victims of intimate partner violence. *Violence and Victims, 18,* 227–238. Retrieved from http://www.ingentaconnect.com/content/springer/vav/2003/00000018/00000002/art00008

Landrigan, P.J., Forman, J., Galvez, M., Newman, B., Engel, S. M., & Chemtob, C. (2008). Impact of September 11 World Trade Center disaster on children and pregnant women. *Mount Sinai Journal of Medicine, 75,* 129-134. doi: 10.1002/ msj.20032

Laplante, D. P., Barr, R. G., Brunet, A., Fort, G. G., Meaney, M. L., Saucier, J. F., ... King, S. (2004). Stress during pregnancy affects general intellectual and language functioning in human toddlers. *Pediatric Research, 56,* 400-410. Retrieved from http:// journals.lww.com/pedresearch/Fulltext/2004/09000/Stress_During_Pregnancy_Affects_General.17.aspx

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping.* New York: Springer.

Lesch, K. P., Bengel, D., Heils, A., Sabol, S. Z., Greenberg, B. D., Petri, S., … Murphy, D. L. (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science, 274,* 1527-1531. doi: 10.1126/science.274.5292.1527

Levendosky, A. A., Leahy, K. L., Bogat, G. A., Davidson, W. S., & von Eye, A. (2006). Domestic violence, maternal parenting, maternal mental health, and infant externalizing behavior. *Journal of Family Psychology,* 20, 544-552. doi: 10.1037/0893-3200.20.4.544

Lopez-Duran N. L., Kovacs, M., & George, C. (2009). Hypothalamic pituitary adrenal axis dysregulation in depressed children and adolescents: A meta-analysis. *Psychoneuroendocrinology, 34,* 1272-1283. doi: 10.1016/ j.psyneuen.2009.03.016

Lovejoy, M.C., Graczyk, P. A., O'Hare, E., & Neuman, G. (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review, 20,* 561-592. doi: 10.1016/S0272-7358(98)00100-7

Luby, J. L., Belden, A. C., & Spitznagel, E. (2006). Risk factors for preschool depression: the mediating role of early stressful life events. *Journal of Child Psychology and Psychiatry, 47,* 1292-1298. doi: 10.1111/j.1469-7610.2006.01672.x

Luby, J. L., Heffelfinger, A., Mrakotsky, C., Brown, K., Hessler, M., & Spitznagel, E. (2003). Alterations in stress cortisol reactivity in depressed preschoolers relative to psychiatric and no-disorder comparison groups. *Archives of General Psychiatry, 60,* 1248-1255. doi: 10.1001/archpsyc.60.12.1248

Lucassen, P. J., Bosch, O. J., Jousma, E., Kromer, S. A., Andrew, R., Seckl, J. R., & Neumann, I. D. (2009). Prenatal stress reduces postnatal neurogenesis in rats selectively bred for high, but not low, anxiety: possible key role of placental 11 beta-hydroxysteroid dehydrogenase type 2. *European Journal of Neuroscience,* 29, 97-103. doi: 10.1111/j.1460-9568.2008.06543.x

Lupien, S.J., King, S., Meaney, M. J., & McEwen, B. S. (2001). Can poverty get under your skin? Basal cortisol levels and cognitive function in children from low and high socioeconomic status. *Development and Psychopathology, 13,* 653-676. doi: 10.1017/S0954579401003133

Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews Neuroscience, 10,* 434-445. doi: 10.1038/nrn2639

Maccari, S., Darnaudery, M., Morley-Fletcher, S., Zuena, A. R., Cinque, C., & Van Reeth, O. (2003). Prenatal stress and long-term consequences: implications of glucocorticoid hormones. *Neuroscience and Biobehavioral Reviews, 27,* 119-127. doi: 10.1016/S0149-7634(03)00014-9

Maccari, S., Piazza, P. V., Kabbaj, M., Barbazanges, A., Simon, H., & Lemoal, M. (1995). Adoption reverses the long-term impairment in glucocorticoid feedback induced by prenatal stress. *Journal of Neuroscience, 15,* 110-116. Retrieved from http://www.jneurosci.org/content/15/1/110.short

Mairesse, J., Lesage, J., Breton, C., Breant, B., Hahn, T., Darnaudery, M., … Viltart, O. (2007). Maternal stress alters endocrine function of the feto-placental unit in rats. *American Journal of Physiology-Endocrinology and Metabolism, 292,* E1526-E1533. doi: 10.1152/ajpendo.00574.2006

Marshall, L. L. (1992). Development of the Severity of Violence Against Women Scales. *Journal of Family Violence, 7*(2), 103-121. doi: 10.1007/BF00978700

Martin, R. P., Noyes, J., Wisenbaker, J., & Huttunen, M. O. (1999). Prediction of early childhood negative emotionality and inhibition from maternal distress during pregnancy. *Merrill-Palmer Quarterly, 45,* 370-391. Retrieved from http://merrillpalmerquarterly.com

Martinez-Torteya, C., Bogat, G. A., von Eye, A., & Levendosky, A. A. (2009). Resilience among children exposed to domestic violence: The role of protective and vulnerability factors. *Child Development, 80,* 562-577. doi: 10.1111/j.1467-8624.2009.01279.x

Martinez-Torteya, C., Bogat, G. A., von Eye, A., Levendosky, A. A., & Davidson, W. (2009). Women's appraisals of intimate partner violence stressfulness and their relationship to

depressive and trauma symptoms. *Violence and Victims, 24*, 707-722. doi: 10.1891/0886-6708.24.6.707

Martinez-Torteya, C., Field, L., Bogat, G. A., Levendosky, A. A., Davidson, W. S., & von Eye, A. (2009). *Prenatal Exposure to Domestic Violence Predicts Infants' Internalizing Behaviors and Temperamental Difficulties*. Poster presented in the American Psychological Association 21st Annual Convention, San Francisco, CA.

McCutcheon, A. L. (1987) *Latent Class Analysis.* Sage University Paper series on Quantitative Applications in the Social Sciences. Beverly Hills and London: Sage Publications.

McEwen, B. S. (2000). Effects of adverse experiences for brain structure and function. *Biological Psychiatry, 48*, 721-731. doi: 10.1016/S0006-3223(00)00964-1

McKinnon, M., Yucel, K., Nazarov, A., & MacQueen, G.. (2009). A meta-analysis examining clinical predictors of hippocampal volume in patients with major depressive disorder. *Journal of Psychiatry & Neuroscience, 34*, 41-54. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2612082/

McLeod, J. D., & Shanahan, M. J. (1996). Trajectories of poverty and children's mental health. *Journal of Health and Social Behavior, 37,* 207-220. Retrieved from http://www.jstor.org/stable/2137292

McLeod, B. D., Weisz, J. R., & Wood, J. J. (2007). Examining the association between parenting and childhood depression: A meta-analysis. *Clinical Psychology Review,* 27, 986-1003. doi: 10.1016/j.cpr.2007.03.001

Meyer, S. E., Chrousos, G. P., & Gold, P. W. (2001). Major depression and the stress system: A life span perspective. *Development and Psychopathology, 13*, 565-580. doi: 10.1017/S095457940100308X

Mohler, E., Parzer, P., Brunner, R., Wiebel, A., & Resch, F. (2006). Emotional stress in pregnancy predicts human infant reactivity. *Early Human Development, 82*, 731-737. doi: 10.1016/j.earlhumdev.2006.02.010

Morrel, T., Dubowitz, H., Kerr, M., & Black. M. (2003). The effect of maternal victimization on children: A cross-informant study. *Journal of Family Violence, 18*, 29-41. doi: 10.1023/A:1021401414414

Mourad, M., Levendosky, A. A., Bogat, G. A., & von Eye, A. (2008). Family psychopathology and perceived stress of both domestic violence and negative life events as predictors of women's mental health symptoms. *Journal of Family Violence, 23,* 661-670. doi: 10.1007/s10896-008-9188-1

Murphy, C. M., & Hoover, S. A. (1999). Measuring emotional abuse in dating relationships as a multifactorial construct. *Violence and Victims, Special Issue: Psychological Abuse in*

Domestically Violent Relationships, *14*, 39-53. Retrieved from http://www.ingentaconnect.com/content/springer/vav/1999/00000014/00000001/art00003

Murray, L., Halligan, S. L., Goodyer, I., & Herbert, J. (2010). Disturbances in early parenting of depressed mothers and cortisol secretion in offspring: A preliminary study. *Journal of Affective Disorders, 122,* 218-23. doi: 10.1016/j.jad.2009.06.034

Muthen, L. K., & Muthen, B. O. (2007). *Mplus User's Guide, Fourth Edition.* Los Angeles, CA: Muthen & Muthen.

NICHD Early Child Care Research Network (1999). Chronicity of maternal depressive symptoms, maternal sensitivity, and child functioning at 36 months: Results of the NICHD Study of Early Child Care. *Developmental Psychology, 35*, 1297-1310. doi: 10.1037/0012-1649.35.5.1297

O'Brien, M., Bahadur, M., Gee, C., Balto, K., and Erber, S. (1997). Child exposure to marital conflict and child coping responses as a predictor of child adjustment. *Cognitive Therapy and Research,* 21, 39-59. doi: 10.1023/A:1021816225846

O'Connor, T. G., Ben-Shlomo, Y., Heron, J., Golding, J., Adams, D., & Glover, V. (2005). Prenatal anxiety predicts individual differences in cortisol in pre-adolescent children. *Biological Psychiatry, 58*, 211-217. doi: 10.1016/ j.biopsych.2005.03.032

O'Connor, T. G., Heron, J., Golding, J., Beveridge, M., & Glover, V. (2002). Maternal antenatal anxiety and children's behavioural/emotional problems at 4 years - Report from the Avon Longitudinal Study of Parents and Children. *British Journal of Psychiatry, 180*, 502-508.doi: 10.1192/bjp.180.6.502

Pendry, P., & Adam, E.K. (2007). Associations between parents' marital functioning, maternal parenting quality, maternal emotion and child cortisol levels. *International Journal of Behavioral Development, 31 (3),* 218–231. doi: 10.1177/0165025407074634

Perks, S. M., & Jameson, M. (1999). The effects of witnessing domestic violence on behavioural problems and depressive symptomatology - A community sample of pupils from St Lucia. West Indian Medical Journal, 48, 208-211. Retrieved from http://apps.webofknowledge.com.proxy1.cl.msu.edu/full_record.do?product=WOS&search_mode=GeneralSearch&qid=5&SID=Q1N33Ho6N82d2Oa4gIi&page=1&doc=1

Pico-Alfonso, M. A., Garcia-Linares, M. I., Celda-Navarro, N., Blasco-Ros, C., Echeburua, E., & Martinez, M. (2006). The impact of physical, psychological, and sexual intimate male partner violence on women's mental health: Depressive symptoms, posttraumatic stress disorder, state anxiety, and suicide. *Journal of Women's Health, 15*, 599-611. doi: 10.1089/jwh.2006.15.599

Pico-Alfonso, M. A., Garcia-Linares, M. I., Celda-Navarro, N., Herbert, J., & Martinez, M. (2004). Changes in cortisol and dehydroepiandrosterone in women victims of physical and psychological intimate partner violence. *Biological Psychiatry, 56,* 233-240. doi: 10.1016/j.biopsych.2004.06.001

Pluess, M., Velders, F. P., Belsky, J., van IJzendoorn, M. H., Bakermans-Kranenburg, M. J., Jaddoe, V. W., ... Tiemeier, H. (2011). Serotonin transporter polymorphism moderates effects of prenatal maternal anxiety on infant negative emotionality. *Biological Psychiatry, 69,* 520-525. doi: 10.1016/ j.biopsych.2010.10.006

Pruessner, J. C., Kirschbaum, C., Meinlschmid, G., & Hellhammer, D. H. (2003). Two formulas for the computation of the area under the curve represent measures of total hormone concentration versus time-dependent change. *Psychoneuroendocrinology, 28,* 916-931. doi: 10.1016/S0306-4530(02)00108-7

Quinlivan, J. A., & Evans, S. F. (2005). Impact of domestic violence and drug abuse in pregnancy on maternal attachment and infant temperament in teenage mothers in the setting of best clinical practice. *Archive of Women's Mental Health, 8,* 191-199. doi: 10.1007/s00737-005-0079-7

Rao, U., Hammen, C., Ortiz, L. R., Chen, L., & Poland, R. E. (2008). Effects of early and recent adverse experiences on adrenal response to psychosocial stress in depressed adolescents. *Biological Psychiatry, 64,* 521-526. doi: 10.1016/ j.biopsych.2008.05.012

Renouf, A. G., & Kovacs, M. (1994). Concordance between mothers' reports and children's self-reports of depressive symptoms: a longitudinal study. *Journal of the American Academy of Child & Adolescent Psychiatry, 33,* 208-216. doi: 10.1097/00004583-199402000-00008

Reynolds, C. R., & Kamphaus, R. W. (2002). *A clinician's guide to the Behavior Assessment System for Children (BASC).* New York: Guilford Publications.

Rhoades, K. A. (2008). Children's responses to interparental conflict: A meta-analysis of their associations with child adjustment. *Child Development, 79,* 1942-1956. doi: 10.1111/j.1467-8624.2008.01235.x

Rice, F., Harold, G. T., Shelton, K. H., Thapar, A. (2006). Family conflict interacts with genetic liability in predicting childhood and adolescent depression. Journal of the *American Academy of Child and Adolescent Psychiatry, 45,* 841-848. doi: 10.1097/01.chi.0000219834.08602.44

Rice, F., Harold, G., Thapar, A. (2002). The genetic aetiology of childhood depression: A review. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 43,* 65-79. doi: 10.1111/1469-7610.00004

Roseboom, T., de Rooij, S., & Painter, R. (2006). The Dutch famine and its long-term consequences for adult health. Early Human Development, 82, 485-491. doi: 10.1016/j.earlhumdev.2006.07.001

Rothenberger, S. E., Resch, F., Dospod, N., & Moehler, E. (2011). Prenatal stress and infant affective reactivity at five months of age. *Early Human Development, 87,* 129-136. doi: 10.1016/j.earlhumdev.2010.11.014

Ryan, N. D., Puig-Antich, J., Ambrosini, P., Robinovitch, H. Robinson, D., Nelson, B., … Twomey, J. (1987). The clinical picture of major depression in children and adolescents. *Archives of General Psychiatry, 44,* 854-861. Retrieved from http://archpsyc.ama-assn.org/content/vol44/issue10/index.dtl

Saltzman, L. E. (1990). Battering during pregnancy: a role for physicians. *Atlanta Medicine, 64*, 45-48. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12295334

Saltzman, L. E., Fanslow, J. L., McMahon, P. M., & Shelley, G. A. (1999). *Intimate partner violence surveillance: uniform definitions and recommended data elements.* Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.

Saltzman, K. M., Holden, G. W., & Holahan, C. J. (2005). The psychobiology of children exposed to marital violence. *Journal of Clinical Child and Adolescent Psychology, 34,* 129-139. doi: 10.1207/s15374424jccp3401_12

Sameroff, A. J. (2000). Developmental systems and psychopathology. *Development and Psychopathology, 12,* 297-312. doi: 10.1017/S0954579400003035

Schwartz, E. B., Granger, D. A., Susman, E. J., Gunnar, M. R., & Laird, B. (1998). Assessing salivary cortisol in studies of child development. *Child development, 69,* 1503-13. doi: 10.2307/1132128

Seedat, S., Stein, M. B., Kennedy, C. M., & Hauger, R. L. (2003). Plasma cortisol and neuropeptide Y in female victims of intimate partner violence. *Psychoneuroendocrinology, 28,* 796-808. doi: 10.1016/S0306-4530(02)00086-0

Silk, J., Shaw, D., Skuban, E. M., Oland, A. A., & Kovacs, M. (2006). Emotion regulation strategies in offspring of childhood-onset depressed mothers. *Journal of Child Psychology and Psychiatry Allied Disciplines, 47,* 69-78. doi: 10.1111/ j.1469-7610.2005.01440.x

Smider, N.A., Essex, M.J., Kalin, N.H., Buss, K. A., Klein, M. H., Davidson, R. J., & Goldsmith, H. H. (2002). Salivary cortisol as a predictor of socioemotional adjustment during kindergarten: A prospective study. *Child Development, 73,* 75-92. doi: 10.1111/1467-8624.00393

Sorensen, M. J., Nissen, J. B., Mors, O., & Thomsen, P. H. (2005). Age and gender differences in depressive symptomatology and comorbidity: an incident sample of psychiatrically admitted children. *Journal of Affective Disorders, 84*, 85-91. doi: 10.1016/j.jad.2004.09.003

South, S.C., & Krueger, R. F. (2011). Genetic and environmental influences on internalizing psychopathology vary as a function of economic status. Psychological Medicine, 41, 107-117. doi: 10.1017/S0033291710000279

Spinrad, T. L., Eisenberg, N., Granger, D. A., Eggum, N. D., Sallquist, J., Haugen, R.G., … Hofer, C. (2009). Individual differences in preschoolers' salivary cortisol and alpha-amylase reactivity: Relations to temperament and maladjustment. *Hormones and Behavior, 56,* 133-139. doi: 10.1016/j.yhbeh.2009.03.020

Sroufe, L. A., Carlson, E. A., Levy, A. K., & Egeland, B. (1999). Implications of attachment theory for developmental psychopathology. *Development and Psychopathology, 11*, 1-13. Retrieved from http://journals.cambridge.org/action/displayJournal?jid=DPP

Stanner, S. A., & Yudkin, J. S. (2001). Fetal programming and the Leningrad Siege Study. Twin Research and Human Genetics, 4, 287-292. doi: 10.1375/twin.4.5.287

Stern, D. N. (1995). The motherhood constellation: A unified view of parent-infant psychotherapy. New York: Basic Books.

Sternberg, K. J., Baradaran, L. P., Abbott, C. B., Lamb, M. E., & Guterman, E. E. (2006). Type of violence, age, and gender differences in the effects of family violence on children's behavior problems: A mega-analysis. *Developmental Review, 26*, 89-112. doi: 10.1016/j.dr.2005.12.001

Sternberg, K., Lamb, M., Greenbaum, C., Cicchetti, D., Dawud, S., Cortes, R. M., … Lorey, F. (1993). Effects of domestic violence on children's behavior problems and depression. *Developmental Psychology, 29*, 44-52. doi: 10.1037/0012-1649.29.1.44

Straus, M. A. (1979). Measuring intrafamily conflict and violence: The Conflict Tactics (CT) Scales. *Journal of Marriage & the Family, 41*, 75-88. doi: 10.2307/351733

Street, A. E., Gibson, L. E., & Holohan, D. R. (2005). Impact of childhood traumatic events, trauma-related guilt, and avoidant coping strategies on PTSD symptoms in female survivors of domestic violence. *Journal of Traumatic Stress, 18*, 245-252. doi: 10.1002/jts.20026

Taggart, L., & Mattson, S. (1996). Delay in prenatal care as a result of battering in pregnancy: cross-cultural implications. *Health Care Women International, 17*, 25-34. doi: 10.1080/07399339609516217

Talge, N. M., Neal, C., & Glover, V. (2007). Antenatal maternal stress and long-term effects on child neurodevelopment: how and why? *Journal of Child Psychology and Psychiatry, 48*, 245-261. doi: 1111/j.1469-7610.2007.01714.x

Tjaden, P., & Thoennes, N. (2000). Extent, nature, and consequences of intimate partner violence: findings from the National Violence Against Women Survey. *Research in Brief*. Washington, DC: U.S. Department of Justice, Office of Justice Programs. Retrieved from http://www.ncjrs.gov/pdffiles1/nij/181867.pdf

Tollenaar, M. S., Beijers, R., Jansen, J., Riksen-Walraven, J. M. A., & de Weerth, C. (2011). Maternal prenatal stress and cortisol reactivity to stressors in human infants. *Stress: The International Journal on the Biology of Stress, 14*, 53-65. doi: 10.3109/10253890.2010.499485

Tolman, R. M., & Rosen, D. (2001). Domestic violence in the lives of women receiving welfare: Mental health, substance dependence, and economic well-being. *Violence against Women, 7*, 141-158. doi: 10.1177/1077801201007002003

Uno, H., Eisele, S., Sakai, A., Shelton, S., Baker, D. E., DeJesus, O., & Holden, J. (1994). Neurotoxicity of glucocorticoids in the primate brain. *Hormones and Behavior, 28*, 336-348. doi: 10.1006/hbeh.1994.1030

Valladares, E., Pena, R., Ellsberg, M., Persson, L. A., & Hogberg, U. (2009). Neuroendocrine response to violence during pregnancy: Impact on duration of pregnancy and fetal growth. *Acta Obstetrica et Gynecologica Scandinavica, 88,* 818-823. doi: 10.1080/00016340903015321

Vallee, M., Mayo, W., Dellu, F., LeMoal, M., Simon, H., & Maccari, S. (1997). Prenatal stress induces high anxiety and postnatal handling induces low anxiety in adult offspring: Correlation with stress-induced corticosterone secretion. *Journal of Neuroscience, 17*, 2626-2636. Retrieved from http://neuro.cjb.net/content/17/7/2626.short

Van den Bergh, B. R. H., van Calster, B., Smits, T., van Huffel, S. & Lagae, L. (2008). Antenatal maternal anxiety is related to HPA-axis dysregulation and self-reported depressive symptoms in adolescence: A prospective study on the fetal origins of depressed moods. *Neuropsychopharmacology*, *33*, 536-545. doi: 10.1038/ sj.npp.1301450

Van den Bergh, B. R. H., & Marcoen, A. (2004). High antenatal maternal anxiety is related to ADHD symptoms, externalizing problems, and anxiety in 8-and 9-year-olds. *Child Development, 75*, 1085-1097. doi: 10.1111/j.1467-8624.2004.00727.x

Van der Toorn, S. L. M., Huizink, A. C., Utens, E. M. W. J, Verhulst, F. C., Ormel, J., & Ferdinand, R. F. (2010). Maternal depressive symptoms, and not anxiety symptoms, are associated with positive mother-child reporting discrepancies of internalizing problems in children: A report on the TRAILS study. *European Child & Adolescent Psychiatry, 19*, 379-388. doi: 10.1007/s00787-009-0062-3

Van Stegeren, A. H., Wolf, O. T., & Kindt, M. (2008). Salivary alpha amylase and cortisol responses to different stress tasks: Impact of sex, *International Journal of Psychophysiology, 69,* 33-40. doi: 10.1016/j.ijpsycho.2008.02.008

Varma, D., Chandra, P. S., Thomas, T., & Carey, M. P. (2007). Intimate partner violence and sexual coercion among pregnant women in India: Relationship with depression and post-traumatic stress disorder. *Journal of Affective Disorders, 102,* 227-235. doi: 10.1016/j.jad.2006.09.026

Vogel, L. C. M., & Marshall, L. L. (2001). PTSD symptoms and partner abuse: Low income women at risk. *Journal of Traumatic Stress, 14*, 569-584. doi: 10.1023/ A:1011116824613

von Eye, A., & Bergman, L. R. (2003). Research strategies in developmental psychopathology: Dimensional identity and the person-oriented approach. *Development and Psychopathology, Special Issue: Conceptual, methodological, and statistical issues in developmental psychopathology: A special issue in honor of Paul E. Meehl, 15*, 553-580. doi: 10.1017/S0954579403000294

Wadhwa, P. D., Sandman, C. A, & Garite, T. J. (2001). The neurobiology of stress in human pregnancy. *Progress in Brain Research, 133,* 131-142. doi: 10.1016/S0079-6123(01)33010-8

Wadsworth, M. E., Raviv, T., Reinhard, C., Wolff, B., DeCarlo, C., & Schachter, L. (2008). An indirect effects model of the association between poverty and child functioning: The role of children's poverty-related stress. *Journal of Loss and Trauma: International Perspectives on Stress and Coping, 13,*156 –185. Retrieved from http://www.cinahl.com/cgi-bin/refsvc?jid=3399&accno=2009892547

Wakshlak, A., & Weinstock, M. (1990). Neonatal handling reverses behavioral abnormalities induced in rats by prenatal stress. *Physiology & Behavior, 48,* 289-92. doi: 10.1016/0031-9384(90)90315-U

Walker, L. A. (1984). Battered women, psychology, and public policy. *American Psychologist,* 39, 1178-1182. doi: 10.1037/0003-066X.39.10.1178

Weinstock, M. (2007). Gender differences in the effects of prenatal stress on brain development and behavior. *Neurochemical Research, 36,* 1730-1740. doi: 10.1007/s11064-007-9339-4

Weiss, B., & Garber, J. (2003). Developmental differences in the phenomenology of depression. *Development and Psychopathology, 15,* 403-430. doi: 10.1017/ S0954579403000221

Welberg, L. A. M., Seckl, J. R., & Holmes, M. C. (2001). Prenatal glucocorticoid programming of brain corticosteroid receptors and corticotrophin-releasing hormone: Possible

implications for behavior. *Neuroscience, 104,* 71-79. doi: 10.1016/S0306-4522(01)00065-3

Welberg, L. A. M., Thrivikraman, K. V., & Plotsky, P. M. (2005). Chronic maternal stress inhibits the capacity to up-regulate placental 11 beta-hydroxysteroid dehydrogenase type-2 activity. *Journal of Endocrinology, 186,* 7-12. doi: 10.1677/joe.1.06374

Wheaton, B. (1996). The domains and boundaries of stress concepts. In H. B. Kaplan (Ed.), *Psychosocial Stress: Perspectives in Structure, Theory, Life-Course, and Methods* (pp. 29-70). San Diego CA: Academic Press.

Wolfe, D. A., Crooks, C. V., Lee, V., McInthyre-Smith, A., & Jaffe, P.G. (2003). The effects of children's exposure to domestic violence: A meta-analysis and critique. *Clinical Child and Family Psychology Review, 6,* 171-187. doi: 10.1023/ A:1024910416164

Xiong, X., Harville, E. W., Mattison, D. R., Elkind-Hirsch, K., Pridjian, G., & Buekens, P. (2008). Exposure to Hurricane Katrina, post-traumatic stress disorder and birth outcomes. *American Journal of the Medical Sciences, 336,* 111-115. doi: 10.1097/MAJ.0b013e318180f21c

Young, A. H., Gallagher, P., & Porter, R. J. (2002). Elevation of the cortisol-dehydroepiandrosterone ratio in drug-free depressed patients. *American Journal of Psychiatry, 159,* 1237-1239. doi: 10.1176/appi.ajp.159.7.1237

Young, E. A., Vazquez, D., Jiang, H., & Pfeffer, C. R. (2006). Saliva cortisol and response to dexamethasone in children of depressed parents. *Biological Psychiatry, 60,* 831-836. doi: 10.1016/j.biopsych.2006.03.077

Youngstrom, E. A., Loeber, R., & Stouthamer-Loeber, M. (2000). Patterns and correlates of agreement between parent, teacher, and male adolescent ratings of externalizing and internalizing problems. *Journal of Consulting and Clinical Psychology, 68,* 1038-1050. doi: 10.1037/0022-006X.68.6.1038

Zareen, N., Majid, N., Naqvi, S., Saboohi, S., & Fatima, H. (2009). Effect of domestic violence on pregnancy outcome. *Journal of the College of Physicians and Surgeons Pakistan, 19,* 291-296.

Zeanah, C. H., Keener, M. A., & Anders, T. F. (1986). Developing perceptions of temperament and their relation to mother and infant behavior. *Journal of Child Psychology and Psychiatry, 27,* 499-512. doi: 10.1111/j.1469-7610.1986.tb00637.x

Zimmermann, L. K., & Stansbury, K. (2004). The influence of emotion regulation, level of shyness, and habituation on the neuroendocrine response of three-year-old children. *Psychoneuroendocrinology, 29,* 973-982. doi: 10.1016/ j.psyneuen.2003.09.003