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Maternal Depressive Symptoms, Acculturative Stress, and the Development of Depressive and  
Anxiety Symptoms in Preschool-age Children

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### Abstract

High levels of emotional and behavioral problems have been reported in preschool-aged Mexican-American children, the fastest growing minority population in the US. Preschool-aged children that experience emotional and behavioral problems are more likely to encounter difficulties at home and in school throughout development than children not experiencing these problems. Research suggests early exposure to maternal stress and depression *in utero* is associated with increased risk for emotional and behavioral problems in young children. This may be particularly salient in vulnerable populations that experience high levels of stressors and maternal depression such as women of Mexican descent. These women not only experience daily life stressors but sociocultural stressors as well, including acculturative stress (i.e., stress associated with the acculturative process), which may affect the developing fetus. Prenatal programming of postnatal offspring psychopathology is poorly understood, especially in the Mexican population. The current study used the fetal programming hypothesis, which states that harmful effects during the prenatal period can affect the developing fetus and have long-term consequences for child development. Preschool age is a particularly important time to assess and treat emotional and behavioral difficulties due to behavioral and neurodevelopmental plasticity at this time. It was hypothesized that 1) prenatal maternal depressive symptoms and acculturative stress would each be associated with depressive symptoms in preschool-aged children, 2) prenatal maternal depressive symptoms and acculturative stress would each be associated with anxiety symptoms in preschool-aged children, 3) prenatal maternal depressive symptoms would moderate the relationship between prenatal maternal acculturative stress and depressive symptoms in preschool-aged children, and 4) prenatal maternal depressive symptoms would moderate the relationship between prenatal maternal acculturative stress and anxiety symptoms

in preschool-aged children. Separate linear regressions suggest that fetal exposure to prenatal maternal depressive symptoms, but not acculturative stress, was associated with greater depressive symptoms in preschool-aged children in one of two measures of childhood depression. However, the relationship between prenatal maternal depression and child depressive symptoms was no longer significant once postpartum depression was controlled. There was no relationship between prenatal maternal depression, prenatal maternal acculturative, and child anxiety. A moderation analysis showed that prenatal maternal acculturative stress may be indirectly associated with the development of child depressive symptoms via maternal depression, such that children exposed to high levels of maternal acculturative stress and low levels of maternal depression during pregnancy had lower levels of depressive symptoms. The narrow range of child depression scores may have limited the ability of the data to adequately test the hypotheses, but the data suggest that there is unlikely to be a simple relationship between prenatal factors such as maternal depressive symptoms and acculturative stress and the development of depressive symptoms in preschool-aged Mexican-American children, but that early life factors likely play a role.

Emotional and behavioral problems in children are associated with decreases in quality of life (U.S. Public Health Service, 2000). Children with emotional and behavioral problems are more likely to experience difficulties in school, behave inappropriately in social situations, feel socially excluded, and engage in delinquent behaviors as adolescents (Eisenberg et al., 2009; Luby, Gaffrey, Tillman, April, & Belden, 2014). Children of Mexican descent are at risk of developing emotional and behavioral problems as the Mexican-American population experience cultural stressors that may contribute to negative outcomes in children (de Leon Siantz, Coronado, & Dovydaitis, 2010). Consistent with this point, higher levels of emotional and behavioral problems have been reported in Mexican children compared to their White counterparts (de Leon Siantz et al., 2010; Calzada, Barajas-Gonzalez, Huang, & Brotman, 2017). These data are of concern as Mexicans and Mexican-Americans are the fastest growing minority population in the United States (U.S. Census Bureau, 2010).

Maternal mental health plays an important role in the development of children. For example, there is strong evidence of a relationship between postpartum maternal mental health and negative child developmental outcomes (e.g., psychopathology; Fergusson, & Lynskey, 1993; Hammen et al., 1987; Johnson, Cohen, Kasen, Smailes, & Brook, 2001; Kersten-Alvarez et al., 2012; Kim-Cohen, Moffitt, Taylor, Pawlby, & Caspi, 2005; Murray, Woolgar, Cooper, & Hipwell, 2001); however, little work has investigated the prenatal period and its impact on later psychopathology in children.

Prenatal exposure to maternal mental health problems can be detrimental for fetal and infant development, making the offspring vulnerable to subsequent disorders (Barker, Eriksson, Forsen, & Osmond, 2002). This risk may be particularly salient in vulnerable populations, such as women of Mexican descent, that experience many stressors (D'Anna-Hernandez et al., 2012;

Luecken et al., 2013). These women not only experience daily life stressors but sociocultural stressors as well, including acculturative stress (Sam & Berry, 2010), which can affect the fetus (D'Anna-Hernandez, Aleman, & Flores, 2015). Acculturative stress refers to the stress caused by the acculturation process (Berry, 2006). It happens because an individual is adapting new behaviors and customs to a new culture while still trying to maintain those of the home culture (Berry, 2006; Castillo, Cano, Chen, Blucker, & Olds, 2008). High levels of acculturative stress have been associated with depressive symptoms in pregnant Mexican-American women (D'Anna-Hernandez et al., 2015). Depression and exposure to stress can be detrimental during the prenatal period as offspring are at higher risk of developing neuropsychiatric disorders, including depression (Van den Bergh, Mulder, Mennes, & Glover, 2005). However, the association between fetal exposure and behavioral and emotional problems in preschool-aged Mexican children is poorly understood. The current study tested the fetal programming hypothesis, which states that harmful effects during the prenatal period can affect the developing fetus and have long-term consequences for development (Barker et al., 2002), to investigate the possible relationship between fetal exposure to maternal mental health difficulties and stressors and child psychopathology in children of Mexican descent.

### **Internalizing behaviors in preschool-aged children**

One in seven children aged 2-8 years meets criteria for a mental, behavioral, or developmental disorder (National Survey of Children's Health, 2011-12). Up to ten percent of preschool-aged children meet criteria for an anxiety disorder and two percent for a depressive disorder (Bufferd, Dougherty, Calson, & Klein, 2011; Dougherty et al., 2015; Egger & Angold, 2006;) and this rate increases during adolescence (Luby et al., 2014; Pine et al., 1998). Importantly, many children that come from vulnerable and underrepresented populations suffer

from untreated disorders. The preschool period can be a critical time point to assess and treat difficulties before children enter formal school (i.e., kindergarten). This period is often overlooked, which can have negative consequences later in development; thus, early interventions should be introduced at this time (Luby, 2010).

**Depression.** Over a decade ago depression in preschoolers appeared to be clinically unrecognized (Egger & Angold, 2006; Lavigne, LeBailly, Hopkins, Gouze, & Binns, 2009; Luby et al., 2014, Luby, 2010). Though depression in preschoolers can be difficult to assess, the most common markers are the child's mood (sadness and/or irritability), activity level (e.g., less active), low pleasure in play, sleep disturbances, and appetite change (Luby et al., 2014). Research studies use parental and teacher reports to assess depressive symptoms in preschool-aged children (Bufferd, Dougherty, & Olino, 2017; de Leon Siantz et al., 2010; Dougherty et al., 2011; Kersten-Alvarez et al., 2012). Children experiencing internalizing behaviors (e.g., depression) during the preschool period show impairment in school and at home (Henin et al., 2005; Ialongo, Edelsohn, & Kellam, 2001; Luby, Belden, Pautsch, Si, & Spitznagel, 2009).

Childhood depression has been linked to negative school outcomes. Children experiencing behavioral and emotional problems are more likely to lose interest in learning, become easily frustrated, and show disruptive behavior in school (Dobbs, Doctoroff, Fisher, & Arnold, 2006; Eisenberg et al., 2009). Depression in children has been linked to poor educational outcomes (e.g., low grades or standardized scores) and limited educational opportunities including dropping out of school as adolescents, all of which can continue to impair the child's quality of life throughout the lifespan (Ialongo et al., 2001). As childhood depression can hinder children's development and accomplishments, it is important to assess child depression and intervene early.

**Anxiety.** Preschool-aged children experiencing an anxiety disorder may worry or show fear in anxiety provoking situations which can lead to symptoms of avoidance, somatic complaints, agitation, restlessness, tantrums, difficulties concentrating, and sleep problems (American Psychiatric Association, 2013). The most common anxiety disorders in preschool-aged children are separation anxiety disorder, social anxiety, and specific phobia (Franz et al., 2013; Dougherty et al., 2013). Childhood anxiety carries substantial risk for experiencing continued anxiety in adulthood (Copeland, Angold, Shanahan, & Costello, 2014; Pine et al., 1998). Children experiencing anxiety can encounter difficulties at home, with peers, and/or in public settings. These children may experience a range of difficulties, including academic underachievement, learning problems, sleep problems, and lack of social skills (Arnold & Doctoroff, 2003; Dobbs et al., 2006; Dougherty et al., 2013; Kovacs & Devlin, 1998; Rapport, Denney, Chung, & Hustace, 2001). For example, Rapport et al. (2001) found that preschoolers with anxiety disorders were less likely to participate, concentrate, and be motivated in preschool, further limiting their academic success.

Anxiety is highly comorbid with depression in adults (Hirschfeld, 2001), and studies focusing on child psychopathology have found that preschool-age children experiencing depressive symptoms also experience anxiety symptoms (Birmaher et al., 2009; Bufferd et al., 2012; Bufferd et al., 2011; Dougherty et al., 2013; Franz et al., 2013; Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013; Pine et al., 1998). Depression and anxiety in preschool-aged children can have detrimental consequences on development due to behavioral and neurodevelopmental plasticity (Johnson, 2001). Thus, this makes the preschool period an important time to introduce early interventions.

### **Maternal factors and negative child emotional and behavioral outcomes**

**Postnatal period.** Postnatal maternal factors may play a role in the development of child psychopathology. The relationship between postnatal maternal factors on child outcomes was one of the first areas researched (Billings & Moss, 1983; Orvaschel, Weissman, Padian, & Lowe, 1981; Weissman, Paykel, & Klerman, 1972). Many studies continue to find links between maternal factors and child psychopathology in the postnatal period. One community sample study found that children of postpartum depressed mothers had lower ego-resiliency (i.e., less capable in regulating their emotions and coping with stress), lower school adjustment, and lower peer social competence than the children with non-depressed mothers (Kersten-Alvarez et al., 2012). In addition, parental psychopathology is linked to preschoolers' psychopathology. For example, anxious parents are more at risk to have anxious children and even mild anxiety in mothers can affect their children's well-being (Ginsburg, Grover, & Ialongo, 2004; West & Newman, 2003; Whaley, Pinto, & Sigman, 1999). Additionally, a study conducted with 3-year-old preschool children found that mothers with a recent anxiety disorder were more likely to have children that meet criteria for an anxiety disorder (Dougherty et al., 2013). Maternal psychopathology may be associated with a negative environment (e.g., low quality infant interactions or insecure mother-infant attachment) that, early in a child's life, can have harmful effects on brain development and later have negative consequences including psychopathology and emotion regulation (Kersten-Alvarez et al., 2012). Depressed mothers are more likely to provide inadequate parenting, stressful family contexts, and poor-quality interactions than non-depressed mothers, and these factors promote behavioral problems in children (Fergusson, & Lynskey, 1993; Hammen et al., 1987; Johnson et al., 2001).

In addition, earlier onset of maternal depression has been linked to negative behavioral child outcomes. Research has shown that children born to mothers with early-onset depression,

especially in the postpartum period, are more at risk to develop depression themselves compared to children whose mothers' depression occur later in the child's life (Goodman et al., 2011; Goodman & Gotlib, 1999; Weissman, Warner, Wickramaratne, & Prusoff, 1988). A study found that early maternal depression (occurring within the first 21 months of the child's birth) and negative parenting behaviors predicted emotional problems and decreased child social acceptance in preschool-aged children (Maughan, Cicchetti, Toth, & Rogosch, 2007). Similarly, another study found that preschool-aged children exposed to maternal depression during the first 18 months of age showed stronger negative responses when losing in a card game compared with children of non-depressed mothers (Murray et al., 2001). Together, this work demonstrates that exposure to maternal depression can affect child development. There is growing research on the development of child psychopathology and maternal factors in the postnatal period but limited work has been done investigating the prenatal period.

**Prenatal period.** Given that 50% of postpartum depressive episodes start during pregnancy (Heileman, Frutos, Lee, & Kury, 2004; Zayas, Cunningham, McKee, & Jankowski, 2002), research has moved to understanding the role of maternal mental health in the prenatal period on child outcomes. The fetal programming hypothesis states that stimuli occurring during the prenatal period may affect the development of the fetus, resulting in long-lasting or permanent effects for the child (Barker et al., 2002). Prenatal depression has been associated with poor health and negative fetal consequences (Davis et al., 2007; Kim-Cohen et al., 2005; van den Bergh et al., 2005). Children born to mothers with mental disorders during pregnancy are at higher risk to experience negative developmental and birth outcomes (Davis et al., 2007; Field, Diego, & Hernandez-Reif, 2006; Selten, van der Graaf, van Duursen, Gispen-de Wied, & Kahn, 1999; van den Bergh et al., 2005). Research has shown that newborns of depressed

mothers showed higher irritability and less activity compared to newborns of non-depressed mothers (Abrams, Field, Scafidi, & Prodromidis, 1995; Field et al., 2006). Another study coded facial expressions of newborns and found that newborns born to depressed mothers showed less interest, less attentiveness, and fewer facial expressions during surprising and happy episodes of the assessment (Lundy, Field, & Pickens, 1997). Research has also shown a link between maternal mental health and infant neurodevelopment (Luoma et al., 2001; Koutra et al., 2013). Koutra and colleagues (2013) found that maternal depressive symptoms during pregnancy were linked to a decrease in cognitive development in infants at 18 months of age. Negative maternal factors during pregnancy have also been associated with negative pregnancy outcomes and later problems in children. For example, O'Connor, Heron, Golding, Beveridge, & Glover (2002) conducted a large study with pregnant women and found that prenatal anxiety was associated with emotional problems in 4-year-olds boys and girls, and conduct problems in only girls. Together, this work shows how exposure to negative maternal psychological factors can affect the developing fetus and have later long-term consequences.

### **Prenatal maternal depression and sociocultural stressors in Mexican Americans**

Prenatal programming of postnatal offspring psychopathology is poorly understood, especially in the Mexican population. Mexican and Mexican-Americans are one of the fastest growing minority population in the United States due to high birth rates (U.S. Census Bureau, 2010), and they are susceptible to many health difficulties that may be prompted by exposure to daily stressors and being of low-income status (Cervantes, Padilla, & de Snyder, 1991; U.S. Census, 2012).

**Maternal depression in Mexican Americans.** Maternal depression occurs in 10-25% of women in the general population (De Tyche et al., 2005; Marcus, Flynn, Blow, & Barry, 2004);

however, this rate is higher in Mexican-American women. Up to 50% of Mexican and Mexican-American mothers have reported high levels of depressive symptoms that meet criteria for a depressive disorder (Beck, Froman, & Bernal, 2005; D'Anna-Hernandez et al., 2015; Heileman et al., 2004). Researchers have found depression to be a common problem in pregnant minority women. Mexican-American mothers are more likely to be of lower socioeconomic status, less educated, and single compared to their Caucasian counterparts (Bernstein, 2007), all of which are risk factors for maternal depression (Beck et al., 2005; Cervantes et al., 1991). Depression during pregnancy can go undiagnosed, especially in minority women, since they are less likely than other women to seek medical treatment due to various barriers (e.g., financial, social support; Ojeda & McGuire, 2006).

The majority of studies on risk factors for depressive symptoms during pregnancy have focused predominantly on White women but of those with minority women, studies have found that high levels of perceived stress and trait anxiety are associated with depressive symptoms during pregnancy (Fortner, Pekow, Dole, Markenson, & Chasan-Taber, 2011). The majority of studies that focus on prenatal depression in Mexican-American women have found that the primary risk factors for prenatal depressive symptoms are discrimination, cultural adaptation, daily stressors, financial hardship (i.e., lower socioeconomic status), and acculturative stress (Acevedo, 2000; D'Anna-Hernandez et al., 2015; Heileman et al., 2004; Walker, Ruiz, Chinn, Marti, & Ricks, 2012; Zeiders, Umaña-Taylor, Updegraff, & Jahromi, 2015). Thus, Mexican women experience higher general life stressors which puts them at higher risk for depression during pregnancy compared to their Caucasian counterparts.

**Maternal cultural stressors in Mexican Americans.** Mexican women deal with cultural stressors (e.g., acculturative stress) that may exacerbate depressive symptoms (D'Anna-

Hernandez et al., 2015). Maternal stress during pregnancy is considered to be a teratogen, which is an agent that negatively affects the development of the fetus (DiPietro, 2012). Women of Mexican descent that migrate to the United States are faced with daily stressors such as language barriers, deportation fears, lack of education, occupational barriers, and discrimination (Cervantes et al., 1991; Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005). In addition to these daily stressors, women of Mexican descent deal with adapting to the norms and beliefs of a new country (i.e., acculturation), which can be stressful (Berry, 2006; Heileman et al., 2004; Sam & Berry, 2010; Zayas et al., 2002). Acculturative stress refers to the stress caused by the acculturation process (Berry, 2006). It happens because an individual is adapting new behaviors and customs to a new culture while still trying to maintain those of the home culture (Berry, 2006; Castillo et al., 2008). Acculturative stress has been associated with poorer mental health such as depression, anxiety, and even suicidal ideation (Hovey & Magana, 2000; Hovey, 2000; Preciado & D'Anna-Hernandez, 2017). Individuals experiencing acculturative stress may feel pulled between two cultures, lose ties from friends and family in the country of origin (Berry, 2006; Hovey, 2000), and encounter difficulties in the new culture (e.g., discrimination, language barriers, and financial difficulties; Cervantes et al., 1991; Hovey & Magana, 2000; Lara et al., 2005). However, the role of acculturative stress on maternal mental health and its association to fetal outcomes needs further investigation.

Previous work has shown that acculturative stress a strong source of the harmful health consequences in the Mexican population (Flores et al., 2008). Acculturative stress has been associated with elevated levels of maternal anxiety symptoms during pregnancy (Preciado & D'Anna-Hernandez, 2017), and research has shown that stress often precedes maternal depressive symptoms (Hammen, 2005). A study with Mexican immigrants found that elevated

levels of acculturative stress were associated with higher depressive symptoms, including suicidal ideation (Hovey, 2000). High levels of acculturative stress are associated with higher depressive symptoms in pregnant Mexican women (D'Anna-Hernandez et al., 2015). These women are at risk to develop depression and anxiety during pregnancy (Beck et al., 2005; Breslau et al., 2011; Zayas et al., 2002), and we know that depressive symptoms in the prenatal period can have harmful effects on the offspring (Goodman et al., 2011; Heileman et al., 2004; Luecken et al., 2013; Luoma et al., 2001; van den Bergh et al., 2005). However, work is needed in investigating the role of acculturative stress on child psychopathology.

### **Present Study**

The current study examined the fetal programming hypothesis and its implications for the development of child depressive and anxiety symptoms during the preschool period in Mexican-American children. It is important to investigate the possible relationship of fetal exposure to maternal psychological factors (i.e., depressive symptoms and acculturative stress) and the development of child psychopathology in Mexican children as these children are more at risk to be born to mothers with depression compared to their White counterparts (Beck et al., 2005; D'Anna-Hernandez et al., 2015; Heileman et al., 2004; Sam & Berry, 2010; Zayas et al., 2002). It was hypothesized that 1) prenatal maternal depressive symptoms and acculturative stress will, each separately, be associated with depressive symptoms in preschool-aged children, 2) prenatal maternal depressive symptoms and acculturative stress will, each separately, be associated with anxiety symptoms in preschool-aged children, 3) prenatal maternal depressive symptoms will moderate the relationship between prenatal maternal acculturative stress and depressive symptoms in preschool-aged children, and 4) prenatal maternal depressive symptoms will

moderate the relationship between prenatal maternal acculturative stress and anxiety symptoms in preschool-aged children.

## **Method**

### **Participants**

A total of 60 pregnant women of Mexican descent (born in the U.S. or Mexico) were recruited for this study. Women were at least 18 years of age and <15 weeks pregnant. Participants include the mother-child dyad. Exclusion criteria were major complications in pregnancy and use of illegal drugs. Children were eligible to participate in the study during preschool age, between 3½ to 5 years old. Children previously diagnosed with chronic medical conditions (e.g., congenital heart abnormalities) and/or developmental disabilities (e.g., autism) were not included in the study.

### **Power Analyses**

A power of analysis was performed using G\*Power 3.1 to calculate the required sample size. All variables were measured as continuous, making our primary analyses multiple regressions. Effect sizes of previous studies examining the effects of maternal factors (e.g., depression and cultural stressors) on child psychopathology were used to calculate sample size (de Leon Siantz, et al., 2010; Vega, Khoury, Zimmerman, Gil, & Warheit, 1995). Using Cohen's  $f^2$  a medium effect size of 0.196 with 80% power and alpha set at 0.05 (Cohen, 1988) it was determined that a sample size of 60 mother-child dyads would be needed for this study.

### **Recruitment**

Participants were recruited from a local community clinic at their regularly scheduled prenatal appointments. A research assistant explained the study to eligible potential participants

and if interested, the participant provided written and oral informed consent in their preferred language (English or Spanish).

### **Procedure**

Participants were assessed at a local clinic twice during their pregnancy and once again at an in-home visit and phone interview when their child were 3½ -5 years old (i.e., the developmental assessment). At the first clinic visit (10-15 weeks gestation), mothers completed demographic and acculturative stress surveys. At the second clinic visit (15-17 weeks gestation) mothers completed depression and perceived stress measures. The last visit (i.e., the developmental assessment) took place when children were between 3½ to 5 years of age at an in-home visit and phone interview. The developmental assessment consisted of two parts. The first part mothers performed a phone interview, the second part mothers were seen in person and completed maternal and child questionnaires. Mothers received \$25 for each prenatal visit and \$60 for the developmental assessment visit (i.e., phone interview and in person). Measures were available in English and Spanish.

### **Measures**

#### ***Acculturative stress***

Acculturative stress was measured using the Societal, Attitudinal, Familial, and Environmental Acculturative Stress (SAFE) scale. The SAFE is a self-report measure that includes 24-items measuring acculturative stress (Padilla, Wagatsuma, & Lindholm, 1985). The SAFE scores on a Likert scale from 0 = *does not apply* to 5 = *extremely stressful*. A sample item is, "People think I am not friendly when in fact I have trouble communicating in English". This scale has been used in Latinos and the Mexican-American population (Fuentes & Westsbrook, 1996) including pregnant Mexican-American women (D'Anna-Hernandez, Aleman, & Flores,

2015). A higher score reflects more acculturative stress. This scale has good reliability scores with a Cronbach's alpha of .90 among Mexican Americans (Hovey, 2000). Mothers completed this scale in the first clinic visit (10-15 weeks gestation) and at the developmental assessment. Cronbach's alpha for the current study was .90.

### ***Perceived Stress***

To control for general stress and isolate the effect of acculturative stress, the Perceived Stress Scale (PSS) was used. The PSS is a 14-item scale (Cohen, Kamarck, & Mermelstein, 1983) that measures general stress-related feelings and thoughts on a 5-point Likert scale for the past month. The scale ranges from "Never/Rarely" to "Very Often". A sample item is, "In the last month, how often have you found that you could not cope with all the things that you had to do?" The PSS has been used to measure general stress in pregnant Mexican-American women (D'Anna-Hernandez, Aleman, & Flores, 2015). A higher score on this scale represents higher perceived stress. This scale has shown good reliability with a Cronbach's alpha of .81 for pregnant Latina women (Mann, Mannan, Quiñones, Palmer, & Torres, 2010). This measure was completed at the second clinic visit (15-17 weeks gestation) and at the developmental assessment. Cronbach's alpha for the current study was .71.

### ***Maternal depressive symptoms***

Mothers were given the Center for Epidemiologic Studies Depression (CES-D) scale to measure maternal depressive symptoms during pregnancy. The CES-D is a self-report scale that measures depressive symptomatology in the general population (Radloff, 1977). This scale has been used in the Mexican-American population (Morton, Schoenrock, Stanford, Peddecord, & Molgaard, 1989) and in pregnant Mexican-American women (D'Anna-Hernandez, Aleman, & Flores, 2015). The CES-D includes 20 items that measure participants' depressive symptoms in a

4-point scale for the past week. An example question is, “I did not feel like eating; my appetite was poor.” Higher scores on the CES-D indicate more depressive symptoms and a score of 16 or higher indicates possible clinical psychological stress (Radloff, 1977). This scale has shown good reliability scores with a Cronbach alpha coefficient of .88 among Mexican women (Heileman et al., 2004). Mothers completed this scale at the second clinic visit (15-17 weeks gestation) and at the developmental assessment. Cronbach’s alpha for the current study was .85.

### ***Child depressive and anxiety symptoms: Interview***

Mothers were interviewed by phone using the Preschool Age Psychiatric Assessment (PAPA) to evaluate their child’s behavior when children were between 3½ to 5 years old (i.e., at the developmental assessment visit). The PAPA is a parent-report clinical diagnostic interview to assess preschool psychopathology for the past three months in children ages 2 - 5 (Egger et al., 2006). To help mothers recall their children’s behavior, the interviewer anchored the time period around an important event (e.g., “Think back three months ago; today is October 8<sup>th</sup>, three months back will be July 8<sup>th</sup>, around 4<sup>th</sup> of July”). The depression and anxiety sections from the interview were used. The PAPA assesses the presence, frequency, and onset of impairment associated with symptoms. All interviews were conducted by a trained native Spanish-speaking graduate student either in English or Spanish depending on the mother’s preference. This interview was conducted over the phone with the mothers’ consent to record the interview. Interviews generally lasted around 90 minutes. Depression and anxiety scores were computed separately by summing the scores for the symptoms included in the depressive and anxiety sections. In addition, impairment ratings in five domains (relationships with parents, siblings, and peers; preschool functioning; age-appropriate activities) were added and summed for a total functioning impairment score (Dougherty et al., 2011; Kim et al., 2012). Overall the Cronbach’s

alpha for the current study was .63 for the depressive scale, and .68 for the anxiety scale. Broken down by language, the Spanish version of the PAPA had a reliability of .65 for the depressive scale and .67 for the anxiety scale. English version had a reliability of .55 for the depressive scale and .74 for the anxiety scale.

### ***Child depressive and anxiety symptoms: Questionnaire***

Mothers completed the Child Behavior Checklist 1½ - 5 (CBCL) on the last visit of the study (i.e., at the developmental assessment). The CBCL is a standard 100-item parent-report measure that assesses the child's behavior and identifies psychopathological characteristics (Achenbach & Rescorla, 2000). Mothers rated each item to the degree to which they believe their child exhibits that behavior on a 3-point scale with a range of "not true" to "very true or often true". The CBCL scale has been well documented and it is one of the most commonly used scales to use for assessing child behavior (Petty et al., 2008). The CBCL assesses the child's behavior and emotions for the past two months. Example items include, "Worries" and "Unhappy, sad, or depressed". This scale has been used in the Latino population to investigate child behavior problems (Gross et al., 2006; Sivan, Ridge, Gross, Richardson, & Cowell, 2008). The CBCL has shown good reliability scores with a Cronbach's alpha of .92 among Latino preschool-aged children (Gross et al., 2006). This measure contains subscales of depressive and anxious behavior. Both the DSM-Affective Problems and DSM-Anxiety Problems scales were used for this study. All scores for depression and anxiety were summed (Caughy, Nettles, & O'Campo, 2008; Dobbs et al., 2006). Overall Cronbach's alpha for the current study was .58 for the depressive scale, and .56 for the anxiety scale. Broken down by language, the Spanish version of the CBCL had a reliability of .60 for the depressive scale and .59 for the anxiety scale. English version had a reliability of .59 for the depressive scale and .34 for the anxiety scale.

### **Statistical Analyses**

To determine possible covariates, the relationship between maternal demographic variables and child outcome variables were examined. Demographic variables included mothers' years in the U.S., years of education, income, and age. All variables were continuous. Correlations between variables of interest were first performed before performing linear regressions to control for covariates in analyses. To test the first two hypotheses that prenatal maternal depressive symptoms and acculturative stress will each be associated with child depressive and anxiety symptoms, separate linear regressions were conducted. In these models, maternal depressive symptoms, acculturative stress, and perceived stress measured at the developmental assessment were entered as covariates. Prenatal maternal depressive symptoms and acculturative stress were entered as independent variables (IVs), and depressive and anxiety scores from the PAPA and CBCL as dependent variables (DVs). These analyses were run separately for each DV.

To test the moderation hypotheses that prenatal maternal depressive symptoms will moderate the relationship between prenatal maternal acculturative stress and child depressive and anxiety symptoms, PROCESS plugin (Model 1, Hayes, 2016) for SPSS was used. In the separate models, prenatal acculturative stress was entered as the IV, prenatal depressive symptoms as the moderating variable (MV), and child depressive and anxiety scores from PAPA and CBCL as DVs. Also, further analyses were conducted with child gender as a moderating variable to test if child gender (MV) moderates the relationship between prenatal maternal depressive symptoms (IV) and child depressive and anxiety symptoms (DVs) from PAPA and CBCL. In addition, moderation analyses were conducted to test if child gender (MV) moderates the relationship between prenatal maternal acculturative stress (IV) and child depressive and anxiety symptoms

(DVs) from PAPA and CBCL. All child gender moderation analyses used PROCESS plugin (Model 1, Hayes, 2016) for SPSS.

## Results

### Sample Characteristics

All mothers in this study were of Mexican descent with the majority of them being born in Mexico (77%). Mother ages ranged from 18 to 42 years old ( $M = 28.85$ ,  $SD = 5.53$ ) at the time of recruitment. Mothers' number of years in the U.S. ranged from 4 to 38 years ( $M = 15.65$ ,  $SD = 7.22$ ). The mean annual household income ( $\pm$  standard deviation) was  $\$29,148 \pm \$1,495$ . The sample included 60 offspring with 50% ( $n = 30$ ) being females and 50% ( $n = 30$ ) being males. Child ages ranged from 3½ to 5 years old with mean age ( $\pm$  standard deviation) of  $3.87 \pm .52$ . All other maternal demographics are included in Table 1.

### Descriptives

Mothers' depressive scores (CES-D) were higher in the prenatal ( $M = 13.360$ ,  $SD = 8.636$ ) than the postnatal ( $M = 9.828$ ,  $SD = 8.176$ ) period ( $t(57) = 3.745$ ,  $p < .001$ ). Mothers' level of acculturative stress (SAFE) was about the same for both prenatal ( $M = 24.140$ ,  $SD = 16.191$ ) and postnatal ( $M = 24.828$ ,  $SD = 14.107$ ) periods ( $t(58) = -.342$ ,  $p = .734$ ). For perceived stress (PSS), mothers experienced about the same levels of stress in the prenatal ( $M = 20.670$ ,  $SD = 7.383$ ) and postnatal ( $M = 21.216$ ,  $SD = 8.205$ ) periods ( $t(57) = -.424$ ,  $p = .673$ ). Children's overall scores were relatively low for both PAPA (Depressive Scale:  $M = 1.967$ ,  $SD = 2.186$ ; Anxiety Scale:  $M = 11.095$ ,  $SD = 7.378$ ) and CBCL (DSM-Affective Problems:  $M = 1.817$ ,  $SD = 1.836$ ; DSM-Anxiety Problems:  $M = 3.007$ ,  $SD = 2.296$ ), respectively. For the PAPA, boys showed slightly more depressive symptoms ( $M = 2.400$ ,  $SD = 2.608$ ) than girls ( $M = 1.533$ ,  $SD = 1.592$ ;  $t(58) = -1.554$ ,  $p = .126$ ), however, girls showed slightly more anxiety symptoms ( $M =$

11.216,  $SD = 7.064$ ) than boys ( $M = 10.974$ ,  $SD = 7.798$ ;  $t(58) = .126$ ,  $p = .900$ ). For the CBCL, boys showed slightly more depressive ( $M = 2.067$ ,  $SD = 1.929$ ;  $t(58) = -1.055$ ,  $p = .296$ ) and anxiety ( $M = 3.133$ ,  $SD = 2.270$ ;  $t(58) = -.422$ ,  $p = .675$ ) symptoms than girls ( $M = 1.567$ ,  $SD = 1.736$ ;  $M = 2.882$ ,  $SD = 2.354$ ).

### **Correlations**

Bivariate correlations between maternal predictors and child depressive and anxiety symptoms from the PAPA and CBCL were computed. Pearson's correlations determined that maternal variables were not significantly associated with child depressive and anxiety symptoms for both the PAPA and CBCL. "Postnatal" will refer to measures from the preschool developmental assessment time point (i.e., when children were 3½ to 5 years of age). Higher levels of prenatal maternal depressive symptoms were correlated with higher levels of child depressive symptoms from both the PAPA ( $r = .274$ ,  $p = .034$ ), and the CBCL ( $r = .272$ ,  $p = .036$ ). Higher levels of postnatal maternal acculturative stress was also associated with higher levels of child depressive symptoms from the PAPA ( $r = .354$ ,  $p = .006$ ). In the postnatal period, higher levels of maternal depressive symptoms ( $r = .439$ ,  $p = .001$ ) and maternal perceived stress ( $r = .401$ ,  $p = .002$ ) were associated with higher levels of child depressive symptoms from the CBCL. Postnatal maternal perceived stress was also associated with more child anxiety symptoms ( $r = .278$ ,  $p = .035$ ) from the PAPA (see Table 2 & 3). Maternal perceived stress was included as a covariate in all models containing maternal acculturative stress as an IV.

### **Maternal depressive symptoms, acculturative stress, and child depressive symptoms**

It was hypothesized that prenatal maternal depressive symptoms and acculturative stress would each be associated with depressive symptoms in preschool-aged children when controlling for postnatal maternal covariates. Separate linear regressions were performed to analyze these

relationships. Prenatal maternal depressive symptoms were not associated with child depressive symptoms from the PAPA when controlling for postnatal maternal depressive symptoms ( $R^2 = .057$ ,  $b = .062$ ,  $t = 1.445$ ,  $p = .154$ , 95%  $CI = [-.024, .148]$ ; see Table 4) or CBCL ( $R^2 = .198$ ,  $b = -.021$ ,  $t = -.639$ ,  $p = .525$ , 95%  $CI = [-.085, .044]$ ; see Table 5). In addition, when controlling for prenatal and postnatal perceived stress and postnatal acculturative stress, prenatal maternal acculturative stress was not a significant predictor of child depressive symptoms from the PAPA ( $R^2 = .198$ ,  $b = -.029$ ,  $t = -1.384$ ,  $p = .172$ , 95%  $CI = [-.072, .013]$ ; see Table 4) or CBCL ( $R^2 = .206$ ,  $b = .023$ ,  $t = 1.309$ ,  $p = .196$ , 95%  $CI = [-.012, .057]$ ; see Table 5). Also, a linear regression was performed with prenatal maternal depressive symptoms and acculturative stress in the same model. Covariates included prenatal and postnatal perceived stress and postnatal maternal depressive symptoms and acculturative stress. Results indicated that neither prenatal maternal depressive symptoms ( $R^2 = .226$ ,  $b = .061$ ,  $t = 1.277$ ,  $p = .208$ , 95%  $CI = [-.035, .158]$ ), nor acculturative stress ( $R^2 = .226$ ,  $b = -.030$ ,  $t = -1.418$ ,  $p = .162$ , 95%  $CI = [-.074, .013]$ ) were significant predictors of child depressive symptoms when using the PAPA or CBCL (prenatal maternal depressive symptoms:  $R^2 = .284$ ,  $b = .023$ ,  $t = .616$ ,  $p = .541$ , 95%  $CI = [-.052, .099]$ ; acculturative stress:  $R^2 = .284$ ,  $b = .018$ ,  $t = 1.056$ ,  $p = .296$ , 95%  $CI = [-.016, .052]$ ; see Table 8 & 9).

### **Maternal depressive symptoms, acculturative stress, and child anxiety symptoms**

It was hypothesized that children of mothers reporting greater levels of each depressive symptoms and acculturative stress would experience more anxiety symptoms at preschool-age when accounting for postnatal maternal factors. Separate linear regressions were performed for these analyses. When controlling for postnatal maternal depressive symptoms, prenatal maternal depressive symptoms did not predict child anxiety symptoms when using the PAPA ( $R^2 = .052$ ,  $b$

=  $-.215$ ,  $t = -1.470$ ,  $p = .147$ , 95%  $CI = [-.508, .078]$ ; see Table 6) or CBCL ( $R^2 = .041$ ,  $b = .024$ ,  $t = .527$ ,  $p = .600$ , 95%  $CI = [-.068, .116]$ ; see Table 7). In addition, when controlling for prenatal and postnatal perceived stress, and postnatal acculturative stress, prenatal acculturative stress did not predict child anxiety symptoms from the PAPA ( $R^2 = .089$ ,  $b = -.037$ ,  $t = -.481$ ,  $p = .633$ , 95%  $CI = [-.191, .117]$ ) or CBCL ( $R^2 = .072$ ,  $b = .005$ ,  $t = .207$ ,  $p = .837$ , 95%  $CI = [-.044, .054]$ ). These relationships were then added in the same model. Covariates included prenatal and postnatal perceived stress, and postnatal maternal depressive symptoms and acculturative stress. A linear regression analysis indicated that neither prenatal maternal depressive symptoms ( $R^2 = .104$ ,  $b = -.157$ ,  $t = -.897$ ,  $p = .374$ , 95%  $CI = [-.508, .194]$ ), nor acculturative stress ( $R^2 = .104$ ,  $b = -.035$ ,  $t = -.452$ ,  $p = .653$ , 95%  $CI = [-.192, .122]$ ) were significant predictors of child anxiety symptoms when using the PAPA or CBCL (maternal depressive symptoms:  $R^2 = .107$ ,  $b = .073$ ,  $t = 1.340$ ,  $p = .186$ , 95%  $CI = [-.036, .183]$ ); acculturative stress ( $R^2 = .107$ ,  $b = .004$ ,  $t = .159$ ,  $p = .874$ , 95%  $CI = [-.045, .053]$ ; see Table 10 & 11).

### **Maternal depressive symptoms as a moderator between acculturative stress and child depressive symptoms**

It was hypothesized that prenatal maternal depressive symptoms would moderate the relationship between prenatal maternal acculturative stress and child depressive symptoms. Five thousand resamples with 95% bias corrected standardized bootstrap confidence intervals were stimulated. Maternal depressive symptoms, acculturative stress, and their interaction was entered to predict child depressive symptoms. Covariates of prenatal and postnatal perceived stress and postnatal maternal acculturative stress and depressive symptoms were entered into the model. Prenatal maternal depressive symptoms significantly moderated the relationship between prenatal acculturative stress and child depressive symptoms from the PAPA ( $R^2 = .342$ ,  $b = .005$ ,

$t = 2.967, p = .005, 95\% CI = [.002, .008]$ ). Our simple slopes analyses suggest that when prenatal maternal depression is high the levels of prenatal maternal acculturative stress doesn't have an effect on child depressive symptoms during preschool-age ( $b = .003, t = .114, p = .909, 95\% CI = [-.043, .049]$ ), however, when prenatal maternal depression is low the levels of prenatal maternal acculturative stress matters, such that mothers who experienced higher levels of acculturative stress and less depressive symptoms early in pregnancy reported less depressive symptoms in their offspring during preschool period ( $b = -.080, t = -3.075, p = .003, 95\% CI = [-.133, -.028]$ ; see Table 8 & Figure 1).

The same above hypothesis and statistical analyses were tested using the CBCL for child depressive symptoms. Prenatal maternal depressive symptoms did not moderate the relationship between prenatal acculturative stress and child depressive symptoms ( $R^2 = .324, b = -.002, t = -1.706, p = .094, 95\% CI = [-.005, .000]$ ; see Table 9).

### **Maternal depressive symptoms as a moderator between acculturative stress and child anxiety symptoms**

It was hypothesized that prenatal maternal depressive symptoms would moderate the relationship between prenatal maternal acculturative stress and anxiety symptoms in preschool-aged children. Five thousand resamples with 95% bias corrected standardized bootstrap confidence intervals were stimulated. Covariates such as prenatal and postnatal perceived stress, postnatal maternal acculturative stress, and postnatal maternal depressive symptoms were entered into the model. Prenatal maternal depressive symptoms did not moderate the relationship between prenatal acculturative stress and child anxiety symptoms when measured using the PAPA ( $R^2 = .112, b = -.004, t = -.671, p = .504, 95\% CI = [-.017, .009]$ ), nor the CBCL ( $R^2 = .123, b = -.002, t = -.942, p = .351, 95\% CI = [-.006, .002]$ ; see Table 10 & 11).

**Child gender as a potential moderator between maternal depressive symptoms, acculturative stress, and child depressive and anxiety symptoms**

Child gender was used as a moderator for the relationship between prenatal maternal depressive symptoms and child depressive symptoms to test for potential sex differences. Five thousand resamples with 95% bias corrected standardized bootstrap confidence intervals were stimulated. After controlling for postnatal maternal depressive symptoms, results indicated that child gender did not significantly moderate the relationship between prenatal maternal depressive symptoms and child depressive symptoms at preschool-age when using the PAPA ( $R^2 = .149$ ,  $b = .102$ ,  $t = 1.562$ ,  $p = .124$ , 95%  $CI = [-.029, .232]$ ); nor when using the CBCL ( $R^2 = .222$ ,  $b = -.010$ ,  $t = -.202$ ,  $p = .841$ , 95%  $CI = [-.112, .091]$ ). In addition, analyses were performed to test if child gender moderated the relationship between prenatal maternal acculturative stress and child depressive symptoms. Covariates in the model included prenatal and postnatal perceived stress and postnatal maternal acculturative stress. Analyses revealed that child gender did not moderate the relationship between prenatal maternal acculturative stress and child depressive symptoms when using the PAPA ( $R^2 = .266$ ,  $b = -.028$ ,  $t = -.857$ ,  $p = .395$ , 95%  $CI = [-.094, .038]$ ), nor the CBCL ( $R^2 = .228$ ,  $b = -.028$ ,  $t = -1.013$ ,  $p = .316$ , 95%  $CI = [-.083, .027]$ ).

Similar analyses were performed to test if child gender moderated the relationship between prenatal maternal depressive symptoms and child anxiety symptoms. Covariates included postnatal maternal depressive symptoms. Results showed that child gender did not moderate the relationship between prenatal maternal depressive symptoms and child anxiety symptoms when using the PAPA ( $R^2 = .081$ ,  $b = .296$ ,  $t = 1.290$ ,  $p = .203$ , 95%  $CI = [-.164, .755]$ ), nor when using the CBCL ( $R^2 = .074$ ,  $b = .092$ ,  $t = 1.273$ ,  $p = .209$ , 95%  $CI = [-.053, .236]$ ). Furthermore, the relationship between prenatal maternal acculturative stress and child

anxiety symptoms was tested using child gender as a moderator. After controlling for prenatal perceived stress and postnatal maternal acculturative and perceived stress, results indicated that child gender did not significantly moderate the relationship between prenatal acculturative stress and child anxiety symptoms at preschool-age when using the PAPA ( $R^2 = .133$ ,  $b = -.186$ ,  $t = -1.538$ ,  $p = .130$  95%  $CI = [-.429, .057]$ ); nor the CBCL ( $R^2 = .115$ ,  $b = -.059$ ,  $t = -1.560$ ,  $p = .125$  95%  $CI = [-.136, .017]$ ).

### Discussion

This study aimed to investigate the fetal programming hypothesis and its role in the development of child depressive and anxiety symptoms during the preschool period in the Mexican population. When not accounting for postnatal maternal depressive symptoms, prenatal maternal depressive symptoms, but not acculturative stress, was associated with greater depressive symptoms, but not anxiety, in preschool-aged children when using both measures. In addition, moderation analyses found that mothers who reported higher levels of acculturative stress and experienced fewer depressive symptoms early in pregnancy, reported fewer depressive symptoms in their preschool-aged children, but not anxiety, when measured by the PAPA. These results varied slightly by measurement of depressive symptoms in children which were done by either CBCL, a parent self-report, or the PAPA, an interviewed-based approach. However, overall results suggest that both prenatal and postnatal maternal depressive symptoms were associated with child depressive symptoms, and prenatal maternal acculturative stress may be indirectly associated with the development of child depressive symptoms via maternal depression.

Two measurements that assesses emotional and behavioral problems in preschool-age children were used, the PAPA and the CBCL. The CBCL is the most commonly used measure in

studies assessing child behavior (Petty et al., 2008). It is a questionnaire in which parents or caregivers report on child behavior symptoms from a symptom checklist. The CBCL can identify relatively stable psychopathological characteristics in preschoolers (Achenbach & Rescorla, 2000). However, the PAPA is a more in-depth measure (Egger et al., 2006). The PAPA contains standardized diagnostic categories from the Diagnostic and Statistical Manual of Mental Disorders (DSM) and it follows a structured format and an interviewer-based approach that provides details about the frequency, duration, and severity of symptoms, unlike the CBCL, which only rates frequency of symptoms. With the CBCL, parents are individually rating the child's behavior but with the PAPA the interviewer decides whether the behavior is impairing or not and if it meets criteria. Research has shown that self-report questionnaires, done alone, can be biased (Adams, Soumera, Lomas, & Ross-Degnan, 1999) because they are based mainly on one informant reporting on the child's behavior (Kroes, Veerman, & De Bruyn, 2003).

Furthermore, maternal depressive symptoms can affect the way mothers report on child behavior (Boyle & Pickles, 1997; Kroes et al., 2003). Work has shown that individuals experiencing a depressive disorder remember more negative events, therefore, rating more negatively (Foland-Ross & Gotlib, 2012). Also, research has shown that parents view their child's behavior differently due to cultural norms and beliefs (Halgunseth, Ispa, & Rudy, 2006). For example, Mexican mothers may view a type of behavior differently compared to White mothers. Research has shown that Mexican mothers teach their children to behave in ways that's traditional to their cultural norms even if the behavior is not the norm in another culture (Zayas & Solari, 1994). Similarly, a study found that Latina mothers had higher tolerance to aggressive behaviors seen in toddlers compared to European mothers, as Latina mothers viewed the child's behavior as playful and with no intent to harm (Mosier & Rogoff, 2003). Due to this, it's possible that the

CBCL is vulnerable to cultural bias. Given that the PAPA is an interviewer-based approach, the interviewer can more objectively code the child's behavior based on developmental norms from the information provided by the parent, reducing such bias. Thus, to be consistent with previous studies assessing child behavior the CBCL was included, and to attempt to decrease bias in interpretation the PAPA was also used in the present study.

Reliability scores for the CBCL scales were low, with a Cronbach's alpha of .58 for the DSM-Affective Problems scale and .56 for the DSM-Anxiety Problems scale. Previous work using the CBCL in preschool-age Mexican children have found low alphas when using the internalizing behaviors scale  $\alpha = .65$  (de Leon Siantz et al., 2010). However, the current study separated depressive and anxiety symptoms, therefore, not using the internalizing behaviors scale ( $\alpha = .88$  for current study), instead we used the DSM-Affective Problems scale to assess depressive symptoms and the DSM-Anxiety Problems scale to assess anxiety symptoms. We did run similar analyses using the internalizing score but no differences were found (data not shown). Due to fewer variables that the DSM-Affective Problems and DSM-Anxiety Problems scales contain, it's possible that the narrow range of child scores may have contributed to the low alphas in the current study. A study comparing behavioral and emotional problems in preschool-age children from 24 societies using the CBCL also found low alphas for the DSM-Affective Problems scale ( $\alpha = .57$ ) and the DSM-Anxiety Problems scale ( $\alpha = .63$ ; Rescorla et al., 2011). The low alphas could be due to limited variables in the scales and low child symptom ratings or it's possible that cultural differences play a role. Research looking into child psychopathology have found differences in child scores when using the CBCL 1½ - 5, with different societies having relatively high or low mean scores (Achenbach et al., 2008), indicating differences possibly due to cultural norms.

**Maternal mental health, psychosocial stress, and child depressive symptoms**

Consistent with previous research, the current study found that prenatal maternal depressive symptoms predicted preschool-age child depressive symptoms when using both the CBCL and PAPA, however, this relationship was lost when controlling for postpartum depressive symptoms. Fetal exposure to prenatal maternal depressive symptoms have previously been linked to negative child behavioral outcomes including depressive symptoms (Brennan et al., 2000; Chang, Halpern, & Kaufman, 2007; Goodman et al., 2011; Goodman & Gotlib, 1999; Koutra et al., 2013; Luoma et al., 2001; van den Bergh et al., 2005). Similar to the current study, a large study found that preschool age children of mothers reporting higher levels of depressive symptoms were reported to experience significantly higher total behavior problems, including depression, using the CBCL (Brennan et al., 2000). Another similar study conducted by Chang and colleagues (2007) found that children of depressed mothers experienced higher internalizing behaviors, including depressive symptoms, compared to children of nondepressed mothers. In addition, even when accounting for postnatal maternal mental health, prenatal maternal mental health problems predict child emotional and behavioral problems (O'Connor et al., 2002). The current study did not replicate this work as it only found evidence of this association when postpartum maternal depressive symptoms were not in the model, however, it is possible that due to a small sample we were not able to detect effects when controlling for maternal factors. The samples of the above studies were large with a total of 4,953 and 6,552 mother-child dyads, respectively, however, it is not clear if the above studies controlled for postnatal maternal depression. Another possibility could be that prenatal maternal depression does not program offspring depression in the Mexican population. Perhaps postnatal maternal factors are more impactful than prenatal. A study looking into maternal mental health in the pre and postnatal

periods found that postpartum maternal depression and stress at two months postnatal predicted higher internalizing problems (depressive symptoms) in offspring during the first school year (Vanska et al., 2011). Similarly, another study found that, in the postnatal period, recent high levels of maternal depressive symptoms predicted higher behavioral problems in preschool-aged children compared to children of mothers with past depression (Alpern & Lyons-Ruth, 1993). Together, these studies suggest that postnatal maternal mental health problems strongly affect child development, including the developmental of depressive symptoms. Overall, this work suggests both pre and postnatal factors are important for child development of behavior programs and it is unclear if one timepoint is more important than the other. More work is needed to investigate these relationships in the Mexican population.

In the current study, acculturative stress was not directly associated with children's depressive symptoms. Little is known about maternal acculturative stress and child behavioral problems. Previous work has found that maternal acculturative stress correlated with child internalizing behaviors in the postnatal period (Leidy, Parke, Cladis, Coltrane, & Duffy, 2009). To date, no work has been done on prenatal maternal acculturative stress and child outcomes; however, in the prenatal period, the role of the related concept of acculturation on fetal programming has begun to be addressed. Acculturation is associated with markers of altered fetal development including early infant gestational age and low infant birth weight (Beck, 2006; Crump, Lipsky, & Mueller, 1999; D'Anna-Hernandez, et al., 2012,). These adverse birth outcomes have been linked to later offspring problems including higher internalizing behaviors and social problems, low IQ scores, and less educational attainment (Dewey & Begum, 2011; Hille et al., 2001; Kerr-Wilson, Mackay, Smith, & Pell, 2011; Moster, Lie, & Markestad, 2008; Talge et al., 2010). However, these studies are inconsistent likely due to proxy measurement of

acculturation (i.e., birthplace, language). More recent work suggests that the stress associated with acculturative process, i.e., acculturative stress, may be a more important cultural factor than acculturation which contributes to mental health outcomes (Caplan, 2007). For example, interactions between acculturative stress and acculturation, but not acculturation alone, contribute to psychological distress in a sample of non-pregnant Latinos (Torres et al, 2012). In pregnancy, acculturative stress, but not acculturation, predicts elevated levels of maternal depressive symptoms, beyond perceived stress, in Mexican women (D'Anna-Hernandez et al., 2015). Together this work suggests acculturative stress may be a unique stressor on maternal mental health. Since it is well known that prenatal maternal depressive symptoms affect fetal development (Brennan et al., 2000; Davis et al., 2011; van den Bergh et al., 2005), it is possible that prenatal maternal acculturative stress may be indirectly associated with offspring development with long-term consequences for depressive symptoms during preschool-age in the Mexican population.

As research has shown that cultural stressors often work together with other variables to affect child outcomes (Leidy et al., 2009; Parke et al., 2004), the current study investigated whether prenatal maternal depressive symptoms would moderate the relationship between prenatal maternal acculturative stress and depressive symptoms in preschool-aged children. Results indicated that there was a significant association when using depressive symptoms from the PAPA only. Our analyses show that when prenatal maternal depression is high the levels of prenatal maternal acculturative stress does not have an effect on child depressive symptoms during preschool-age. However, when prenatal maternal depression is low the levels of prenatal maternal acculturative stress matters, such that mothers who experienced higher levels of acculturative stress and less depressive symptoms reported less depressive symptoms in their

offspring during preschool period. Therefore, the level of prenatal maternal depression seems to be driving the association between acculturative stress and child psychopathology. This interaction suggests that low prenatal maternal depression may be buffering the effects of high prenatal maternal acculturative stress on child depressive symptoms. Similar work has also found interactions between cultural stressors and maternal factors on child behavior, particularly acculturative stress affecting marital or parenting quality. For example, Leidy and colleagues (2009) found that higher parent acculturative stress mediated the relationship between lower positive marital quality and more child internalizing behaviors in Mexican-Americans. Parke et al. (2004) found that more acculturated parents had less marital quality, but less hostile parenting, both of which were linked to child maladjustment via the CBCL. A similar study by Corona and colleagues (2012) found that poor maternal parenting quality was associated with higher child depressive symptoms. Thus, the association between marital and parenting quality on children's behavior may depend on acculturative processes the parents are experiencing. It's possible that our mothers experiencing low levels of maternal depression had better marital or parenting quality which help buffer the effects of high acculturative stress which in turn contributed to their children experiencing less depressive symptoms, however, our study did not address marital or parenting quality. Of all sixty mothers in our study, only eight were single or not living with the biological father. These high rates of marriage in the current study reflect current census data (Pew Research Center, 2017) and agree with other work that shows Mexican women highly value marriage (East, 1998; Landale, Schoen, & Daniels, 2010). Thus, the strong marriages seen in our sample may have buffered the effects of acculturative stress on child behavior. Similarly, Calzada and colleagues (2013) conducted a study about familism, "*familismo*", on low-income Mexican families and found that Mexican families have a strong

bond and put family first before the individual. *Familismo*, as a protective factor, could be another explanation for our moderation results. Perhaps mothers experiencing high levels of acculturative stress had stronger cultural values and rated their children more favorably due to the strong ties to family that underlies *familismo* (Calzada, Tamis-LeMonda, & Yoshikawa, 2013). Mothers also could have rated the children more positive due to social desirability as seen in previous work (Fisher & Katz, 2000). Overall, results from the present study suggest that cultural, family, and acculturative processes may work together to indirectly influence child behavior problems.

### **Effects of maternal mental health and psychosocial stress on child anxiety symptoms**

In the current study, neither prenatal maternal depressive symptoms nor prenatal maternal acculturative stress were directly or indirectly associated with child anxiety symptoms. Previous research has found associations between prenatal maternal depression and offspring behavior problems, including anxiety symptoms (Barker, Jaffee, Uher, & Maughan, 2011; Dawson et al., 2003; Goodman et al., 2011), but to date no studies have investigated maternal acculturative stress. In predominately Caucasian samples, preschool-aged children are experiencing higher internalizing behavioral problems, including anxiety symptoms, as well as psychiatric disorders (Bufferd et al., 2012, Lavigne et al., 2009; Rogers, Lenze, & Luby, 2013) compared to our sample. The previously mentioned studies (Barker et al., 2011; Dawson et al., 2003) were largely done in White populations and there may be cultural differences for why we did not replicate prenatal programming of child anxiety in a population of Mexican descent. Mexican American children may be exhibiting fewer behavioral problems (e.g., anxiety symptoms) during the preschool period compared to their Caucasian counterparts or there may be a cultural difference in reporting or perception of such symptoms. Research suggests that Mexican parents may view

their child's behavior differently than White parents (Halgunseth et al., 2006). For example, because individuals approach social situations with a mindset of cultural norms and beliefs (Halgunseth et al., 2006), it's possible that our mothers viewed *fear* behavior differently. Perhaps mothers viewed fear questions (e.g., fear of the dark, doctor, animals, etc.) as the child being whiny rather than the child exhibiting anxious or phobic behavior. Anecdotal evidence from the PAPA interview supports this idea. Some of the mothers mentioned the word "*llorón*" in questions about anxiety, indicating that the child is just being "whiny" rather than viewing the behavior as impairing. In fact, complaining is not viewed favorably in Mexican cultural, even when in pain (Callister, 2003; Calvillo, & Flaskerud, 1991; Villarruel, 1995). Research shows that Mexican women accept and endure more pain to protect others (Villarruel, 1995), thus they may expect the same from their children. Thus, it is possible that cultural differences in perception of fear and anxiety may account for the lower levels of child behavior problems observed in the current study.

### **Strength and Limitations**

This study has several strengths. First, this is one of the first studies to longitudinally investigate prenatal programming of child psychopathology in the Mexican population. Studies that have focused on this subject either investigated very early in development (D'Anna-Hernandez et al., 2012; Crump et al., 1999) or did not include both prenatal and postnatal time points (de Leon Siantz et al., 2010; Smith, Grau, Duran, & Castellanos, 2013). Second, this study investigated the preschool period (ages 3-5) which is an important social and biological developmental time point. The preschool age is a sensitive period and early interventions can take advantage of behavioral and neurodevelopmental plasticity (Johnson, 2001). Also, this study assessed child depressive and anxiety symptoms separately, not internalizing behavior problems

lumped together, and used two symptom measures for a more thorough analysis of child behavior. Lastly, this study was conducted on the fast-growing Mexican population and research has shown that up to 50% of Mexican women meet criteria for depression (Beck et al., 2005; D'Anna-Hernandez et al., 2015; Heileman et al., 2004), thus making this population at high risk for mental disorders.

However, there are several limitations. The present study did not account for other maternal mental health symptoms, such as anxiety, which may have influenced child behavior, though we did control for perceived stress and current depressive symptoms. In addition, child behavior was only reported by mothers and no other informant (e.g., father, adult siblings, teachers). Previous work has shown having multiple informants provide a more complete understanding of the child's behavior (van Dusen Randazzo, Landsverk, & Ganger, 2003). Also, on average, mothers had been in the U.S. for 15 years. It is possible that more recent immigrants may have more varied or higher levels of acculturative stress. In addition, the sample size may have been small to detect effects in the linear regression and differences in the moderations. Additionally, it is possible that we did not detect certain effects due to overall low depressive and anxiety symptom ratings of children in this sample. Further, the study collected data from all participants (i.e., 60 mother-child dyads), however, participants from this study are part of a larger longitudinal study and more families were called to come in but not all returned for their last visit (i.e., developmental assessment). It is possible that mothers of more depressed or anxious children were less likely to participate again compared to mothers of less depressed or anxious children. Also, it's possible we did not use the *appropriate* measures to assess child depressive and anxiety symptoms. Perhaps the PAPA and CBCL, both self-reports, are not culturally useful due to cultural differences in perception of child behavior (Halgunseth et al.,

2006). Assessments like observations (e.g., laboratory observations) should be considered when assessing children of different cultural backgrounds. Lastly, the current study did not account for other possible environmental factors that could have influenced the child's behavior (e.g., sibling/peer relationships, neighborhood).

### **Conclusion**

This study is one of the first studies to longitudinally examine the relationship between prenatal maternal depressive symptoms, acculturative stress, and the development of depressive and anxiety symptoms in preschool-age Mexican-American children. The findings of this study suggest that both prenatal and postnatal maternal depressive symptoms are associated with the development of child depressive symptoms, however, when accounting for postnatal maternal depressive symptoms prenatal maternal depressive symptoms were no longer associated with child depressive symptoms. In addition, prenatal maternal acculturative stress may be indirectly associated with the development of child depressive symptoms via maternal depression. These findings add to a growing body of evidence that the early life (prenatal to first three years of age) is a vulnerable time for child exposure to maternal factors that can have a long-term effect on offspring development (Barker et al., 2002). This study brings to light maternal factors early in pregnancy that may interact, such as depressive symptoms and acculturative stress, that may impact child development in the fast-growing Mexican population. Thus, these factors could be incorporated into culturally sensitive health care in pregnancy to promote healthy development of preschool children of vulnerable backgrounds as the preschool period is a sensitive time for neurodevelopment.

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Table 1. Maternal Characteristics

Characteristics	N	%
Age		
18-20	5	8.3
21-29	26	43.4
30-39	28	46.7
>40	1	1.6
Place of birth		
United States	14	23.3
Mexico	46	76.7
Years of education		
<12	24	40
12	25	41.6
>12	10	16.6
Unknown	1	1.8
Annual household income		
<\$9,999	4	6.7
\$10,000-\$19,999	10	16.6
\$20,000-\$29,999	23	38.3
\$30,000-\$39,999	8	13.4
>\$40,000	15	25
Language		
Spanish	31	51.7
English	2	3.3
Both	27	45
Employment status		
Full-time	12	20
Part-time	16	26.7
Unemployed	32	53.3
CES-D score		
< 16	40	66.6
> 16	20	33.4
Offspring		
Females	30	50
Males	30	50

Table 2.

*Pearson Correlation Coefficients between Maternal Depression, Acculturative stress, Perceived stress, Maternal and Child Demographics, and Child Depressive and Anxiety Symptoms for PAPA*

Variables	1	2	3	4	5	6	7	8
1. Child Depression (PAPA)	--							
2. Child Anxiety (PAPA)	.156	--						
3. Prenatal acculturative stress	.120	.055	--					
4. Prenatal depression	.274*	-.036	.314*	--				
5. Prenatal perceived stress	.148	-.016	.333**	.572***	--			
6. Postnatal acculturative stress	.354**	.042	.480***	.093	.062	--		
7. Postnatal depression	.147	.121	.372**	.636***	.347**	.162	--	
8. Postnatal perceived stress	.171	.278*	.408***	.249	.222	.274*	.605***	--

*Note.* All variables are maternal variables except Child Depression (PAPA) and Child Anxiety (PAPA). Postnatal refers to the developmental assessment. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

Table 3.

*Pearson Correlation Coefficients between Maternal Depression, Acculturative stress, Perceived stress, Maternal and Child Demographics, and Child Depressive and Anxiety Symptoms for CBCL*

Variables	1	2	3	4	5	6	7	8
1. Child Depression (CBCL)	--							
2. Child Anxiety (CBCL)	.597***	--						
3. Prenatal acculturative stress	.241	.093	--					
4. Prenatal depression	.272*	.198	.314*	--				
5. Prenatal perceived stress	-.001	.019	.333**	.572***	--			
6. Postnatal acculturative stress	-.034	-.005	.480***	.093	.062	--		
7. Postnatal depression	.439***	.191	.372**	.636***	.347**	.162	--	
8. Postnatal perceived stress	.401**	.254	.408***	.249	.222	.274*	.605***	--

*Note.* All variables are maternal variables except Child Depression (CBCL) and Child Anxiety (CBCL). Postnatal refers to the developmental assessment. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

Table 4.

*Separate Linear Regression Statistics for Prenatal Maternal Factors Predicting Offspring Depressive Symptoms using the PAPA*

Predictor	$R^2$	$b$	$t(55)$	$p$	95% CI	$b$	$t(53)$	$p$	95% CI
Model 1	.057								
Postnatal depression		-.002	-.052	.958	[-.093, .089]				
Prenatal depression		.062	1.445	.154	[-.024, .148]				
Model 2	.198								
Postnatal acculturative stress						.074	3.251	.002**	[.029, .120]
Postnatal perceived stress						.027	.740	.463	[-.046, .100]
Prenatal perceived stress						.041	1.055	.296	[-.037, .120]
Prenatal acculturative stress						-.029	-1.384	.172	[-.072, .013]

*Note.* Covariates in model 1 include postnatal maternal depression. Covariates in model 2 include prenatal perceived stress, postnatal acculturative stress, and postnatal perceived stress. Postnatal refers to the developmental assessment. \*\*  $p < .01$ .

Table 5.

*Separate Linear Regression Statistics for Prenatal Maternal Factors Predicting Offspring Depressive Symptoms using the CBCL*

Predictor	$R^2$	$b$	$t(55)$	$p$	95% CI	$b$	$t(53)$	$p$	95% CI
Model 1	.198								
Postnatal depression		.109	3.211	.002**	[.041, .178]				
Prenatal depression		-.021	-.639	.525	[-.085, .044]				
Model 2	.206								
Postnatal acculturative stress						-.021	-1.128	.265	[.058, .016]
Postnatal perceived stress						.087	2.945	.005**	[.028, .146]
Prenatal perceived stress						-.041	-1.291	.202	[-.104, .023]
Prenatal acculturative stress						.023	1.309	.196	[-.012, .057]

*Note.* Covariates in model 1 include postnatal maternal depression. Covariates in model 2 include prenatal perceived stress, postnatal acculturative stress, and postnatal perceived stress. Postnatal refers to the developmental assessment. \*\*  $p < .01$ .

Table 6.

*Separate Linear Regression Statistics for Prenatal Maternal Factors Predicting Offspring Anxiety Symptoms using the PAPA*

Predictor	$R^2$	$b$	$t(55)$	$p$	95% CI	$b$	$t(53)$	$p$	95% CI
Model 1	.052								
Postnatal depression		.254	1.646	.106	[-.055, .563]				
Prenatal depression		-.215	-1.470	.147	[-.508, .078]				
Model 2	.089								
Postnatal acculturative stress						.023	.273	.786	[-.143, .188]
Postnatal perceived stress						.285	2.178	.034*	[.023, .548]
Prenatal perceived stress						-.074	-.525	.602	[-.357, .209]
Prenatal acculturative stress						-.037	-.481	.633	[-.191, .117]

*Note.* Covariates in model 1 include postnatal maternal depression. Covariates in model 2 include prenatal perceived stress, postnatal acculturative stress, and postnatal perceived stress. Postnatal refers to the developmental assessment. \*  $p < .05$ .

Table 7.

*Separate Linear Regression Statistics for Prenatal Maternal Factors Predicting Offspring Anxiety Symptoms using the CBCL*

Predictor	$R^2$	$b$	$t(55)$	$p$	95% CI	$b$	$t(53)$	$p$	95% CI
Model 1	.041								
Postnatal depression		.038	.779	.439	[-.059, .135]				
Prenatal depression		.024	.527	.600	[-.068, .116]				
Model 2	.072								
Postnatal acculturative stress						-.013	-.508	.614	[-.066, .039]
Postnatal perceived stress						.078	1.885	.065	[-.005, .161]
Prenatal perceived stress						-.020	-.455	.651	[-.109, .069]
Prenatal acculturative stress						.005	.207	.837	[-.044, .054]

*Note.* Covariates in model 1 include postnatal maternal depression. Covariates in model 2 include prenatal perceived stress, postnatal acculturative stress, and postnatal perceived stress. Postnatal refers to the developmental assessment.

Table 8.

*Multiple Regression Statistics for Prenatal Maternal Factors Predicting Offspring Depressive Symptoms using the PAPA*

Predictor	$R^2$	$b$	$t(51)$	$p$	95% CI	$b$	$t(50)$	$p$	95% CI
Model 1	.226								
Perceived stress		.009	.190	.850	[-.083, .101]	.037	.844	.403	[-.051, .125]
Postnatal acculturative stress		.072	3.097	.003**	[.025, .118]	.065	3.001	.004**	[.022, .109]
Postnatal depression		-.021	-.391	.697	[-.130, .087]	-.002	-.030	.976	[-.104, .101]
Postnatal perceived stress		.032	.720	.475	[-.058, .122]	-.001	-.025	.980	[-.087, .085]
Prenatal depression		.061	1.277	.208	[-.035, .158]	-.091	-1.331	.189	[-.227, .046]
Prenatal acculturative stress		-.030	-1.418	.162	[-.074, .013]	-.103	-3.261	.002**	[-.167, -.039]
Model 2	.342								
Pre accul x Pre depression						.005	2.967	.005**	[.002, .008]

*Note.* Accul = Maternal acculturative stress. Pre = prenatal. Covariates in model 1 and 2 include all postnatal variables and prenatal perceived stress. Postnatal refers to the developmental assessment. \*\*  $p < .01$ .

Table 9.

*Multiple Regression Statistics for Prenatal Maternal Factors Predicting Offspring Depressive Symptoms using the CBCL*

Predictor	$R^2$	$b$	$t(51)$	$p$	95% CI	$b$	$t(50)$	$p$	95% CI
Model 1	.284								
Perceived stress		-.068	-1.898	.063	[-.140, .004]	-.082	-2.258	.028*	[-.154, -.009]
Postnatal acculturative stress		-.019	-1.067	.291	[-.056, .017]	-.016	-.905	.369	[-.052, .019]
Postnatal depression		.062	1.468	.148	[-.023, .147]	.053	1.261	.213	[-.031, .127]
Postnatal perceived stress		.052	1.477	.146	[-.019, .122]	.068	1.896	.064	[-.004, .139]
Prenatal depression		.023	.616	.541	[-.052, .099]	.095	1.697	.096	[-.018, .208]
Prenatal acculturative stress		.018	1.056	.296	[-.016, .052]	.052	2.002	.051	[-.000, .105]
Model 2	.324								
Pre accul x Pre depression						-.002	-1.706	.094	[-.005, .000]

*Note.* Accul = Maternal acculturative stress. Pre = prenatal. Covariates in model 1 and 2 include all postnatal variables and prenatal perceived stress. Postnatal refers to the developmental assessment. \*\*  $p < .05$ .

Table 10.

*Multiple Regression Statistics for Prenatal Maternal Factors Predicting Offspring Anxiety Symptoms using the PAPA*

Predictor	$R^2$	$b$	$t(51)$	$p$	95% CI	$b$	$t(50)$	$p$	95% CI
Model 1	.104								
Perceived stress		.005	.032	.975	[-.331, .341]	-.019	-.115	.090	[-.366, .326]
Postnatal acculturative stress		.030	.359	.721	[-.139, .200]	.036	.424	.673	[-.135, .208]
Postnatal depression		.072	.365	.716	[-.324, .488]	.055	.273	.786	[-.347, .456]
Postnatal perceived stress		.262	1.611	.113	[-.065, .590]	.292	1.722	.091	[-.049, .633]
Prenatal depression		-.157	-.897	.374	[-.508, .194]	-.022	-.082	.935	[-.559, .515]
Prenatal acculturative stress		-.035	-.452	.653	[-.192, .122]	.029	.235	.815	[-.220, .279]
Model 2	.112								
Pre accul x Pre depression						-.004	-.671	.504	[-.017, .009]

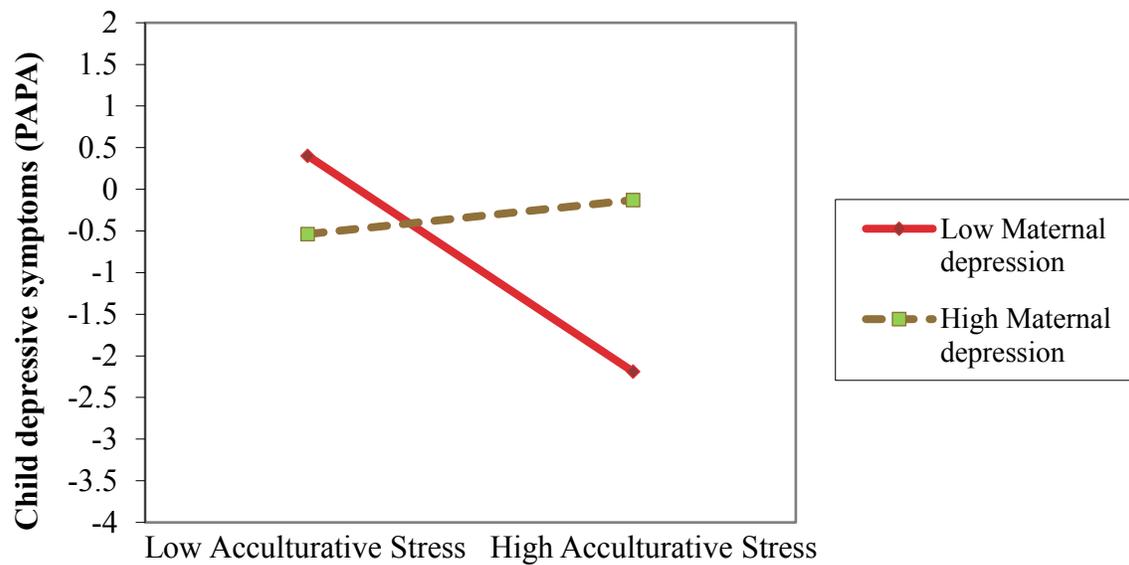
*Note.* Accul = Maternal acculturative stress. Pre = prenatal. Covariates in model 1 and 2 include all postnatal variables and prenatal perceived stress. Postnatal refers to the developmental assessment.

Table 11.

*Multiple Regression Statistics for Prenatal Maternal Factors Predicting Offspring Anxiety Symptoms using the CBCL*

Predictor	$R^2$	$b$	$t(51)$	$p$	95% CI	$b$	$t(50)$	$p$	95% CI
Model 1	.107								
Perceived stress		-.059	-1.126	.266	[-.162, .046]	-.069	-1.302	.198	[-.177, .038]
Postnatal acculturative stress		-.017	-.626	.532	[-.069, .036]	-.014	-.528	.599	[-.067, .039]
Postnatal depression		-.027	-.433	.667	[-.150, .097]	-.034	-.552	.584	[-.159, .090]
Postnatal perceived stress		.085	1.672	.101	[-.017, .187]	.098	1.858	.069	[-.008, .204]
Prenatal depression		.073	1.340	.186	[-.036, .183]	.132	1.589	.118	[-.035, .299]
Prenatal acculturative stress		.004	.159	.874	[-.045, .053]	.032	.829	.411	[-.046, .109]
Model 2	.123								
Pre accul x Pre depression						-.002	-.942	.351	[-.006, .002]

*Note.* Accul = Maternal acculturative stress. Pre = prenatal. Covariates in model 1 and 2 include all postnatal variables and prenatal perceived stress. Postnatal refers to the developmental assessment.



*Figure 1.* Unstandardized regression coefficients of the relationship between prenatal maternal acculturative stress and child depressive symptoms at preschool-age, as moderated by prenatal maternal depressive symptoms. There was a significant interaction of prenatal depressive symptoms on the relationship between acculturative stress and child depressive symptoms as measured by the PAPA ( $R^2 = .342, p = .005$ ). Our simple slopes analyses suggest that when prenatal maternal depression is high the levels of prenatal maternal acculturative stress doesn't have an effect on child depressive symptoms during preschool-age, however, when prenatal maternal depression is low the levels of prenatal maternal acculturative stress matters, such that mothers who experienced higher levels of acculturative stress and less depressive symptoms early in pregnancy reported lower depressive symptoms in offspring during preschool period ( $b = -.080, t = -3.075, p = .003, 95\% CI = [-.133, -.028]$ ).