CALIFORNIA STATE UNIVERSITY SAN MARCOS

THESIS SIGNATURE PAGE

THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF ARTS

IN

PSYCHOLOGICAL SCIENCE

THESIS TITLE: THE ROLE OF MATERNAL CULTURAL STRESSORS IN OBESITY-RELATED OUTCOMES AT BIRTH AND FOUR MONTHS OF AGE

AUTHOR: Eva Victoria Urbina

DATE OF SUCCESSFUL DEFENSE: May 7, 2018

THE THESIS HAS BEEN ACCEPTED BY THE THESIS COMMITTEE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN PSYCHOLOGICAL SCIENCE

Dr. Kimberly D'Anna-Hernandez THESIS COMMITTEE CHAIR	SIGNATURE	5/9/18 DATE
Dr. Carrick Williams THESIS COMMITTEE MEMBER	SIGNATURE	5/9/2018 DATE
Dr. Daniel Berry THESIS COMMITTEE MEMBER	SIGNATURE	5/9/2018 DATE

The Role of Maternal Cultural Stressors in Obesity-Related Outcomes at Birth and Four Months of Age

Eva Urbina

California State University San Marcos

Table of Contents

Abstract

Latinos experience obesity at higher rates than their white counterparts, but the reasons for this disparity are unknown. Latinos, particularly those of Mexican descent, are one of the fastest growing ethnic groups in the United States today; therefore, their high rates of obesity are a pertinent United States health issue. The Prenatal Programming Hypothesis and Fetal Origins of Adult Disease Hypothesis (FOAD) suggest that maternal stress experienced during pregnancy is associated with adverse birth outcomes that have been linked to obesity and enduring disease risk in offspring. Less is understood about the types of maternal stressors that contribute to lifelong obesity risk among infants of Mexican descent. Previous works have shown that greater acculturation, a cultural adaptation process, is associated with poorer health outcomes in Mexican Americans, but the potential unique contribution of its related stressors to overweight risk factors in Mexican American infants remains largely unknown. The present study analyzed the effects of acculturation related cultural stressors, acculturative stress and perceived discrimination stress, experienced by Mexican American pregnant women on early life obesity risk factors in their offspring. It was hypothesized that increased cultural stressors experienced by mothers during pregnancy would be associated with offspring's earlier gestational age, lower weight percentile, lower BMI percentile, and lower head circumference percentile at birth, as well as rapid weight gain rate, BMI gain rate, and head circumference growth rate at 4 months. Cultural stressors were not found to predict infant outcomes. However, greater maternal pre-pregnancy BMI was shown to predict greater infant gestational age at birth, weight percentile at birth, and BMI percentile at a newborn wellness visit. Increased maternal number of previous deliveries was also found to predict decreased infant BMI change at 4 months. Study findings indicate maternal health factors as salient predictors of infant factors related to obesity at birth,

within a week of birth, and at 4 months of age and have implications for Mexican American mental health needs. The potential role of acculturation related factors, including cultural stressors, require further study.

The Role of Maternal Cultural Stressors in Obesity-Related Outcomes at Birth and Four Months of Age

Obesity is a pertinent US health issue that disproportionately affects ethnic minorities, including Latinos (Committee on Accelerating Progress in Obesity Prevention, 2012; Ogden, Carroll, Kit & Flegal, 2014). This is cause for concern because Latinos, primarily those of Mexican descent, are one of the fastest growing ethnic groups in the US today (Heilemann, Frutos, Lee & Kury, 2004; US Census Bureau, 2004). The Prenatal Programming Hypothesis (Barker, 2004) suggests that offspring *in utero* environments influence gene expression and that this has an enduring impact on offspring development both in the scope of normal growth and adult disease susceptibility. In line with this, the Fetal Origins of Adult Disease Hypothesis (FOAD) (Gluckman et al., 2008) constitutes that adult disease risk has its roots in poor fetal environments. These literature support maternal factors, including stress, as primary mechanisms in suboptimal fetal environments and that consequent suboptimal birth outcomes contribute to adult illness risk via altered growth patterns (Barker, 2004; Gluckman et al., 2008).

Research shows that suboptimal infant birth outcomes influence lifelong development and disease risk, including obesity. Throughout various literature maternal stress has been shown to predict infant birth outcomes related to obesity risk (Camacho, 2008; Copper et al., 1996; McCubbin, Lawson, Cox, Sherman, Norton & Read, 1996; Rondó, Ferreira, Nogueira, Ribeiro, Lobert & Artes, 2003; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). Earlier gestational age at birth (Law, 2001; Ong et al. 2002) as well as lower weight at birth are risk factors for overweight and overweight related diseases later in life (Ekelund et al., 2007). This is believed to occur because infants that are smaller at birth typically experience compensatory supplementary growth during the first two years life called catch-up growth (Ekelund et al., 2007). Mexican Americans face increased numbers of stressors during the process of acculturation which encompasses social, psychological, and behavioral changes (Berry, 2005; Elder, Broyles, Brennan & Nader, 2005), but the effects of these cultural stressors on fetal development remains largely unexplored. Therefore, the present study sought to explore the effect of cultural stressors, acculturative stress -the stress derived from the acculturation process and perceived discrimination stress -the stress related to unfair treatment or lack of opportunity based on group membership, experienced by Mexican American mothers during pregnancy on infant gestational age as well as weight, body mass index (BMI), and head circumference at birth and at 4 months. Two hypotheses were tested. First, it was expected that increased cultural stressors would be associated with earlier gestational age, as well as decreased weight percentile, BMI percentile and head circumference percentile at birth. Second, it was expected that increased cultural stressors would be associated with more rapid weight, BMI, and head circumference gain at 4 months.

Maternal Stress during Pregnancy as Predictor of Infant Outcomes

Psychological stress—the anticipation, whether reasonable or not, that a disruption to homeostasis is eminent (Sapolsky, 2005)—has been associated with adverse physical effects in adults such as increased susceptibility to heart diseases, metabolic imbalance, and suppressed immune function (Gianaros & Wager, 2015; Priyadarshini, Aich, & Esteban, 2012). The outcomes of these effects are not limited to the person under stress. The perinatal period is a time of increased stress in women and infant dependence on mother health. Homeostatic processes that accompany maternal stress and their biochemical components are hypothesized to influence the fetal environment and signal fetal homeostatic system development changes (Barker, Bagby & Hanson, 2006). The Prenatal Programming and Fetal Origins of Adult Disease (FOAD) hypotheses suggest that these changes adversely affect overall offspring development that they have lifelong implications for offspring disease risk (Sandman et al., 1994). Adverse fetal environments have been associated with increased risk of preterm birth and low birthweight (LBW) (Luecken et al. 2015; Sandman et al., 1994; Talge, Neal, & Glover 2007) as well as other adverse health outcomes later in life, such as depressive symptoms in offspring at 11 years of age (Slykerman et al., 2015). Moreover, the Prenatal Programming and FOAD hypotheses assert that there are critical periods in fetal development in which the mother's environment may affect infant gene expression. In regard to adverse effects of prenatal stress exposure, the first trimester of pregnancy has been shown to be a particularly vulnerable time (Glynn et al., 2010). Previous studies have examined the impact of prenatal stress related to experiencing stressful life events (Zhu et al., 2010), earthquakes (Glynn et al., 2001), and terrorist attacks (Camacho, 2008) on infant outcomes and experiencing these stressors in first trimester, but not the second or third trimester, was associated with preterm birth (Zhu et al., 2010) and lower birthweight (Camacho, 2008; Glynn et al., 2001; Zhu et al., 2010). In addition, literature has suggested that in some women complications late in pregnancy originate in the early weeks of pregnancy (Smith, 2004). As an ethnic minority of generally low socioeconomic status (SES), Mexican Americans are at greater risk than the broader US population of experiencing stress during pregnancy, including economic and stress derived from experiencing the process of cultural adaptation. These may potentiate adverse birth and later life health outcomes (Canady et al., 2009; Goldberg, Culhane, Lams, & Romero, 2008). Therefore, Mexican Americans may be at increased risk of exposure to adverse fetal environments and subsequent health issues.

Acculturation effects on Mexican American health. Acculturation is defined as constant contact between two cultural groups that results in changes in values, beliefs and/or behaviors of one or both groups (Berry, 2005). Acculturation is a bidirectional and multidimensional process. Rather than abandonment of one culture and a complete shift to a new culture, it can involve varying degrees of adopting new and retaining old cultural values and traditions (Benet-Martinez et al., 2002; Campos et al., 2007; Chun et al. 2003). Previous research has shown that individuals can simultaneously retain two cultural identities and that these can have discrete effects on social behaviors and perceptions (Gonzales et al., 2008; Haritatos & Benet-Martinez, 2002; Roche et al., 2012). In Mexican Americans, acculturation has been associated with diminishing health, but these conclusions are limited by the use of proxy measures (such as primary language or place of birth) which do not capture the degree to which ideologies or behavioral patterns derive from either Mexican or Anglo culture (Acevedo, 2000; Gorman & Krueger, 2010; Masel, Rudkin & Peek, 2006). In general, Latinos, Mexican Americans included, upon arriving in the US tend to exhibit better health outcomes than their non-Latino white counterparts despite having relatively less education and lower income (Campbell, Garcia, & Granillo, 2012). This phenomenon has been termed the Latino Health Paradox (Campbell et al., 2012). The occurrence of this phenomenon has been observed in adults, children, and infants, but the literature shows across them, that the initial advantage is not enduring (Campbell et al., 2012). Evidence in the last couple of decades has demonstrated an adverse *health assimilation* pattern (Johnson-Motoyama, 2014). The diminishing nature of Latino health has been shown to be associated with the acculturation process (Redfield, Linton, & Herskovitz, 1935; Berry, 2005), yet, the mechanisms that underlie this occurrence are not fully understood. Some research highlights cultural stressors during the acculturation process as the underpinnings of this effect. The present study explored the effects of maternal prenatal exposure to cultural stressors that accompany acculturation and their association with risk for obesity in Mexican American infants.

Acculturation and Cultural Stressors in Mexican Americans during Pregnancy

Mexican Americans are a group of generally low socioeconomic status (SES) (US Census Bureau, 2012), and this puts them at increased risk of experiencing adverse health outcomes (Kuh et al., 2002; Lawlor, Ebrahim & Smith, 2002; Braveman, & Gottlieb, 2014). Minority and low-income women disproportionately experience adverse infant outcomes related to perinatal chronic stress (Behrman & Butler, 2007), but the reasons for this are unknown. Mexican Americans experience cultural stressors related to the acculturation process at higher rates than the general population. Specifically, acculturative stress, the stress associated with the process of acculturation, and perceived discrimination stress, defined as stress related to perceived differential treatment or lack of opportunity based on group membership (Allport, 1954, 1979; Feagin & Eckberg, 1980). It is possible that these additional sources of stress contribute to disparities in adverse infant outcomes related to perinatal chronic stress observed in the Mexican American population. These increased stressors may contribute to allostatic load, dysfunction in over-activated neuro-endocrine mechanisms used to maintain homeostasis when the body is faced with stress (McEwen & Stellar, 1993). Previous work in adults, has demonstrated higher allostatic load scores among Mexican Americans than white Americans (Kaestner, Pearson, Keene & Geronimus, 2009). Further, increased time in the US has been associated with higher allostatic load in Mexican American women (Kaestner et al., 2009; McClure et al., 2015), but the reasons for this occurrence are unknown.

Although acculturative stress and perceived discrimination stress are positively correlated, research indicates that they have orthogonal negative (health) outcomes.

Acculturative stress has been associated with poor health (Finch et al., 2001) and depressive symptoms (Driscoll & Tones, 2013) in Latino individuals. In line with this, among pregnant Mexican American women, acculturative stress has been associated with higher depressive symptoms when controlling for general perceived stress, but its effects on infant outcomes remain unknown (D'Anna-Hernandez et al., 2015). Perceived discrimination, however, has been more extensively associated with poor health outcomes. Across various ethnic groups perceived discriminations stress predicts poor mental health (Ertel et al., 2012), increased hypertension risk, sexual dysfunction, nutritional risk, physical fatigue, and increased abdominal fat, among other symptoms (Harris et al., 2006; Zamboni & Crawford, 2007, as cited in Williams & Mohammed, 2009). Among pregnant immigrant women in New Zealand, perceived discrimination has been associated with higher evening cortisol in late pregnancy and cortisol reactivity in offspring (Thayer & Kuzawa, 2015), suggesting dysfunction in stress-related endocrine system in the perinatal period. In Black and African-American pregnant women, perceived discrimination has been shown to contribute to depressive symptoms (Ertel et al., 2012), increased smoking behavior during pregnancy (Nguyen et al., 2012), and very low birth weight (Collins et al., 2000). Among Latina Americans, the likelihood of delivering a LBW infant has also been shown to increase as the level of perceived discrimination rises, but Mexican American outcomes were not independently analyzed (Earnshaw et al., 2013). It is possible that Mexican Americans are more susceptible to adverse health effects associated with cultural stressors because they face heightened health risk factors. Among these various health risk factors, Mexican Americans have lower educational attainment than the general Latino population –with 10% of Mexicans over 25 obtaining a bachelors degree compared to 13% of all US Latinos, the rate of poverty among Mexican Americans is slightly higher than the general

Latino population (27% vs. 25% in foreign-born and 29% vs. 26% in US-born), and Mexican Americans are less likely to have health insurance than other Latino sub-groups (33% vs. 30% are uninsured) (Gonzalez-Barrera, 2013). As indicated by the literature, cultural stressors likely pose a threat to mother and infant health. Yet, how these stressors may contribute to perinatal health disparities and subsequent obesity risk among Mexican American remains unanswered. The proposed study addressed this gap in the literature by investigating the effects of acculturative stress and perceived discriminations stress on infant health indices at birth as well as at 4 months of age.

Birth Outcomes Predict Long-Term Development in Children

Infant measurements at birth and early in life are associated with growth and development and can indicate risk for developing diseases throughout the lifespan (Fawke, 2007; Hovi et al., 2015). This trend follows the David Barker's FOAD hypothesis which asserts that events early in development have substantial impact on one's risk of developing disease in adulthood, including obesity (Barker, 2004). Obesity is a leading health issue in the United States today and has been shown to affect Mexican Americans at higher rates compared to the general American population (Long, Mareno, Shabo, & Wilson, 2012).

Infant outcomes and obesity risk. One third of United States (US) adults and 17% of US youth are obese, but rates of obesity are highest among ethnic minority populations (Behrman & Butler, 2007; Ogden, Carroll, Kit & Flegal, 2014). Latinos experience obesity at a rate of 42.5% compared to 34.5% in white Americans (Ogden et al., 2014). Although lifestyle choices are a widely recognized contributor to obesity risk, there is recent evidence to support that suboptimal birth outcomes may be a pertinent contributor. Health indices at birth, such as early gestational age and LBW, are associated with lifelong adiposity-related disease risk in offspring including coronary heart disease and obesity (Barker et al. 1989; Frankel et al., 1996; Hua et al., 2016) via catch-up growth, the body's natural growth compensation process (Latal-Hajnal et al., 2003). Research shows that children who gain weight quickly from birth to age one are at risk for obesity later in life (Stettler, Zemel, Kumiyaki, & Stallings, 2002) and this may be due to compensation in weight being concentrated in the abdominal region (Ibanez et al. 2006; Law et al., 1992).

Catch-up growth. Infants born small tend to exhibit a natural growth compensation process in the first 2 years of life (Tanner, 1994), called catch-up growth, that is characterized by rapid weight gain (Knops et al., 2005; Latal-Hajnal et al., 2003). However, this process contributes to negative health outcomes for the child. Catch-up growth has been shown to occur in infants born preterm and benefit neurodevelopment (Latal-Hajnal et al., 2003), but it has also been shown to have detrimental effects on weight trajectory and subsequent disease risk (Sullivan, McGrath, Hawes & Lester, 2008). Rapid growth early in life has been associated with overweight and overweight-related diseases including: obesity, cardiovascular disease risk factors, metabolic syndrome, and insulin resistance (Law, 2001; Ong et al. 2002; Dennison, Edmunds, Stratton & Pruzek, 2006; Ong, 2007). Infants that exhibit catch-up growth have been shown to have a relatively greater increase of abdominal fat (Ibanez et al. 2006; Law et al., 1992). Moreover, studies have shown faster weight gain from birth to 6 weeks of age to predict greater truncal fat at 6 months (Pirinçci et al., 2010) and increased adiposity at 6 months is related to increased weight later in childhood (Stout et al. 2015). In addition, heightened catch-up growth in the first two years of life has been associated with greater body fat percentage at age 5 (Ong et al., 2000). In line with this, rapid weight gain at various time points during the first year of life has been associated with later life obesity risk (Pirinçci et al., 2010; Stout et al. 2015).

Specifically, multiple studies have shown that rapid weight gain at 3 months (Stettler et al., 2002) and 4 months (Stettler et al., 2003; Leunissen, 2009) predict overweight in childhood and adulthood. Although research shows early weight gain to predict increased weight during infancy and weight later in life, the role of cultural stressors in this association remains unexplored. Further, whether this is a potential explanation for obesity risk among the Mexican American population also remains unknown. The focus of this project was to explore the potential association between discrete cultural stressors in Mexican American mothers and infant health indices at birth as well as rapid growth patterns early in infancy.

Preterm birth. Forty weeks gestation is considered a full-term pregnancy and preterm birth is generally defined as a live birth occurring prior to 37 weeks gestation (Basten, Johnson, Gilmore, & Wolke, 2015; Goldenberg, Culhane, Iams, & Romero, 2008). Preterm infants are at increased risk of experiencing long-term health issues, including visual, respiratory, auditory, and other neuro-sensory problems (Fawke, 2007). Moreover, preterm births account for 75% of perinatal mortality (Mccormick, 1985). However, even infants born at earlier time points within the full term range of 37 to 41 weeks gestation, have been found to be at increased risk of experiencing developmental deficits (Espel et al., 2014; Spong, 2013; Zhang & Kramer, 2009). Because these issues stem from a lack of intrauterine development, birth at any time prior to 40 weeks gestation puts infants at risk for health complications (Espel, Glynn, Sandman, & Davis, 2014). In addition, infants born early and/or small for gestational age typically exhibit catch-up growth. Maternal stress during pregnancy has been associated with preterm birth and earlier gestational age at birth (Camacho, 2008; Copper et al., 1996; McCubbin et al., 1996;)Therefore, understanding the potential effects of cultural stressors on gestational age at birth can inform the possibility of a resulting catch-up growth pattern underlying increased obesity among Mexican Americans.

Low birthweight. Although often directly related to gestational age, LBW has been independently found to be related to adverse infant development. Contemporary research has found that even after controlling for SES, a circumstance broadly recognized as a predictor of adverse health outcomes, adults who were LBW as infants had higher risk of chronic disease onset by age 50 than those who were normal weight at birth (Johnson & Schoeni, 2011). In particular, cardiovascular health has been identified as a prominent area of concern for LBW infants. Research has shown higher propensity for coronary heart disease and its risk factors in LBW infants, including increased blood pressure in childhood and higher resting heart rate in adulthood (Barker et al. 1989; Frankel et al., 1996; Hua et al., 2016). Catch-up growth/rapid weight gain resulting from LBW is one of the mechanisms believed to underlie such effects.

Head circumference. Head circumference is measured at birth as an assessment of proper development *in utero* (Barbier et al., 2013) and during infancy. Abnormal head circumference at birth may indicate congenital, genetic, or developed neurologic problems (Kim, 2014), and specific head circumference growth patterns have been associated with medical disorders such as Autism spectrum disorder (Whitehouse, 2011). Recently, a study on Finnish children found that head circumference at birth was associated with earlier adiposity rebound (Erikkson et al. 2014). Adiposity rebound is the age in childhood when BMI is at its lowest before increasing again, at an age of six months (Erikkson et al. 2014). Earlier adiposity rebound has previously been shown to be a risk factor for obesity, via altered trajectory of growth (Hughes et al., 2013; Williams & Goulding, 2009). This area of research is still in its infancy.

However, these findings point to head circumference as a potential indicator of obesity risk that can be further explored in the Mexican American population.

The Current Study

The acculturation process has been associated with obesity risk in immigrant populations, but the reasons for this effect are unknown. Acculturation's derived stressors—acculturative stress and perceived discrimination stress—are hypothesized predictors of this effect and have been shown to independently potentiate adverse health outcomes in non-pregnant populations. Experiencing stress is perhaps most striking during the perinatal period, a time when experiencing stress is associated with offspring lifelong health risk, including adiposity-related diseases. However, these implications have yet to be explored in the fast-growing vulnerable Mexican American population. Therefore, this study asked whether acculturative stress, and perceived discrimination stress experienced early in pregnancy by Mexican American women would predict early indices of obesity-risk of their infants. Early pregnancy was a period of focus in this study because previous research has shown the first trimester to be the most vulnerable time when exposure to high stresses in mothers results in adverse infant outcomes (Camacho, 2008; Glynn et al., 2001; Zhu et al., 2010). This study tested the following two hypotheses:

Hypothesis 1: Cultural Stressors would be associated with gestational age, weight percentile BMI percentile, and head circumference at birth in that, 1a: Greater acculturative stress in mothers during pregnancy would be associated with earlier infant gestational age as well as lower weight percentile, lower BMI percentile, and lower head circumference percentile at birth and 1b: Greater perceived discrimination stress in mothers during pregnancy would be associated earlier infant gestational age as well as lower weight percentile, lower BMI percentile, and lower head circumference percentile at birth.

Hypothesis 2: Greater cultural stressors would be associated with rapid weight gain, BMI gain, and head circumference growth rate at 4 months in that, 2a: Greater acculturative stress in mothers during pregnancy would be associated with rapid weight and BMI gain as well as head circumference growth at 4 months and 2b: Greater perceived discrimination stress in mothers during pregnancy would be associated with rapid weight and BMI gain as well as head circumference growth at 4 months

Method

Participants

Participants (N = 92) were recruited from community clinics in the north San Diego county area. Participants were recruited during early pregnancy (i.e., 10-15 weeks). Early pregnancy was chosen, as this time is a critical period in which maternal stress has a greater impact on infant health outcomes. Furthermore, this recruitment period reduced the risk of miscarriage, which occurs more frequently in the first trimester (Larsen, Christiansen, Kolte & Macklon, 2013). In order to participate in the study, women were required to be over the age of eighteen, self-identify as of Mexican descent based on place of birth or lineage, speak English or Spanish, and be non-smoking because adverse effects of smoking may parallel those that we are seeking in this study (Kramer, 1987; Robinson, Moore, Owens, & McMillen, 2000). Participants were also required to have a healthy singleton pregnancy to control for possible variation that may result from including mothers that are pregnant with multiples including the higher likelihood of earlier gestational age and lower weight percentile at birth (Luke & Keith, 1992; Luke, Minogue, Witter, Keith, Johnson, 1993). The study was approved by the California State University San Marcos Institutional Review Board (IRB).

Design

This correlational study examined acculturative stress and perceived discrimination stress in mothers as predictors of offspring outcomes during infancy. In line with the proposed hypotheses, infant gestational age and weight information was derived from birth information in the infants' medical records. However, due to challenges in attaining infant length (to calculate BMI) and head circumference measures at birth from medical records, these scores were acquired from a newborn wellness visit that typically occurred within a week of birth. Infants were 4.84 days old on average at this "newborn wellness visit". Because newborn BMI and head circumference measures were acquired from a new born wellness visit that occurred days after birth, infant age at the newborn wellness visit (Age at time point 1) and difference in infant age between newborn wellness visit and four month wellness visit (Age at time point 2 – age at time point 1) were entered as covariates in change rate analyses for these two outcomes. There was no data missing at the four month time point. Infants were 126.51 days (4.16 months) old on average at this time point. Weight gain rate ((4 month weight - Birthweight)/Days of Age), BMI gain rate ((4 month wellness visit BMI – newborn wellness visit BMI)/Days of Age), and head circumference growth rate ((4 month head circumference – newborn wellness visit head circumference)/Days of Age) at four months were calculated using a formula previously used in a similar previous study (Stettler et al., 2002). In addition to covariates, all analyses controlled for general perceived stress to account for the potential influence of general stress on reported acculturative stress and perceived discrimination stress and acculturation (Mexican Orientation and Anglo Orientation) because this is a theoretically relevant factor.

Procedure

Recruitment. Based on the previously assessed needs of this population, researchers and research assistants were fluent in both English and Spanish in order to provide assistance to participants as needed. Female researchers or research assistants approached prospective participants in the waiting room of the obstetrics care unit of the clinic at their regular 10-15 week gestation visit. If a person met study requirements and wished to take part in the study, they were consented in order to proceed.

Informed consent. The consenting process lasted around 45 minutes and provided information on measures to be collected at each study visit respectively, potential benefits and risks of participating in the study, the right to opt out of answering any questions or participating in any procedure at any time during the study, and the ability to leave the study at any time. The researcher or research assistant provided additional clarification or help, if needed complete informed consent and all questionnaires that were administered.

Data collection. Questionnaire measures were collected during two routine prenatal care clinic visits in early pregnancy. Cultural questionnaires (acculturative stress, perceived discrimination stress, and acculturation) were collected at the initial study visit when maternal participants were 10-15 weeks pregnant. A general perceived stress questionnaires was collected when maternal participants were 15-17 weeks pregnant. Maternal participants completed questionnaires while they were waiting to see their care provider and/or after seeing their care provider. Maternal medical release forms were acquired at a routine prenatal care clinic visit in late pregnancy. Infant medical release forms were acquired at an in-home visit within two weeks post-partum. All questionnaire and demographic forms were available in English and Spanish. Participants were compensated $25 for each study visit.

Measures

Demographics. Participants provided contact information and demographic information including maternal age, primary language, place of birth, years living in the US, years of education, income, marital status, and number of previous deliveries. Maternal pre-pregnancy height and weight information was also collected at this time to calculate maternal pre-pregnancy BMI. Access to maternal records was acquired at a 33-35 weeks gestation clinic visit and records were acquired once the mother gave birth. Maternal pre-pregnancy height and weight (to calculate BMI) were crosschecked with medical records when available.

Cultural Measures

Acculturative stress. Acculturative stress was measured using the Societal, Attitudinal, Familial, and Environmental Acculturative Stress Scale (Mena, Padilla, and Maldonado, 1987), a 24-item scale. Questions regard daily life and do not require participants to consider a particular timeframe when answering. Example items include: “It bothers me that family members that I am close to do not understand my new values”, “I don't feel at home", and "People look down upon me if I practice customs of my culture." Answers range from "Does not apply" to "Extremely stressful” on a 0 to 5 Likert-type scale. Studies have shown this scale to have good reliability among Hispanics and Mexican Americans with Cronbach’s alphas of .89 and .88 (Fuertes & Westbrook, 1996; Hovey, 2000). The SAFE has also been used to assess acculturative stress in association with depression in Mexican American mothers (Hovey & Magaña, 2002; Shatell et al. 2008). This measure was administered at the initial <15 weeks gestation clinic visit. This study sample showed high internal consistency in response on the SAFE (Cronbach’s α = .92).

Perceived discrimination. Perceived discrimination was assessed using the Discrimination Stress Scale (DSS), a 14-question measure with good internal consistency (Cronbach's α = 0.92 Flores et al., 2008). Questions regard daily life and do not require participants to consider a particular timeframe when answering. Questions include: "How often do you feel rejected by others due to your race or ethnicity?", "How often have you seen friends treated badly because of their race or ethnicity?", and "How often do you not get as much recognition as you deserve for the work you do, just because of your race or ethnicity?". Persons answer "Never" to "Very Often" on a 4-point Likert scale. This scale has previously been used to assess discrimination in association with increased physical and mental symptoms in Mexican origin adults (Flores et al., 2010) and in Mexican American pregnant women (Preciado & D'Anna-Hernandez, 2016). This measure was administered at the initial <15 weeks gestation clinic visit. This study sample showed high internal consistency in response on the DSS (Cronbach's α =.92).

Acculturation. Acculturation was measured using the Acculturation Rating Scale for Mexican Americans – II (ARSMA-II) (Cuellar, Arnold & Maldonado, 1995). Previous studies have used this measure with Mexican Americans (Cachelin et al., 2006, Williams & Rueda, 20016) and Latina pregnant women (Jones & Bond, 1999). Three assessment items are: "I enjoy reading books in Spanish", "My friends, while I was growing up, were of Anglo origin ", and "I like to identify myself as a Mexican." Participants answer "Not at all" to "Extremely often or almost always" on a 5 point Likert-type scale. The ARSMA-II contains two subscales: Mexican Orientation and Anglo Orientation. Among pregnant women of Mexican descent, Mexican orientation and Anglo orientation have been shown to have distinct patterns of association with perceived stress, pregnancy anxiety, and infant birthweight (Campos et al., 2007). Given this information, although the difference of the total scores of these scales can be interpreted as an assimilation score denoting the degree of cultural shift that the individual has experienced, taken separately Mexican orientation and Anglo orientation scores can tell us more precisely how the degree of ascribing to either culture distinctly impacts our outcomes of interest. Therefore, in the present study Mexican orientation and Anglo orientation scores of the ARSMA-II were utilized as discrete indicators of acculturation. This measure was administered at the initial <15 weeks gestation clinic visit. The present study showed a Cronbach's alpha of .94 for the Anglo orientation subscale and a Cronbach's alpha of .81 for the Mexican orientation subscale.

General perceived stress. General perceived stress was measured using the Perceived Stress Scale (PSS), a 14-question measure developed by Cohen et al. (1983) to measure feelings of stress in the past month. Two sample questions are: "In the last month how often have you found yourself thinking about things that you had to accomplish?" and "In the last month how often have you felt difficulties were piling up so high that you could not overcome them?" Participants answer "Never/Rarely" to "Very Often." on a 5 point Likert-type scale. Cohen et al. (1983) showed a coefficient alpha reliability for the PSS of 0.84, 0.85, and 0.86 in three distinct samples. This measure was utilized because it has been used in previous studies on pregnant and postpartum Latinas (Mann et al., 2010), and it has also been used in an investigation on Latino caregivers (Gallagher-Thompson et al., 2010). This was administered at a regular prenatal clinic visit at 15- 17. This time point was chosen because of the questionnaire's "in the last month" framing encompasses the late first trimester/early second trimester timeframe at which cultural stressor measures were collected. Giving this questionnaire at a later time reduced the likelihood of participant fatigue because the first study visit was the longest study visit since it included informed consent, collection of demographic information, and questionnaires. The present study showed a Cronbach's alpha of .74 for this scale.

Birth outcomes. Infant outcomes at birth, at a routine newborn wellness visit, and at and at a routine 4-month medical check-up were collected via medical records. Mothers provided consent to allow researchers to access infant medical records. Consent for infant medical record access was acquired from mothers at the first regularly scheduled postnatal study visit, occurring within 1 week of infant birth. Medical records were acquired once the infant was 5 months old to ensure that 4 month visit measures would be included in the record –attending the 4 month checkup was susceptible to delay due to missed appointments, provider reschedule, etc. Medical records were provided to researchers in either paper or electronic form. Physical copies were kept in a locked cabinet in a locked office that could only be accessed by study researchers. Electronic copies were kept on an external hard-drive that was password protected, stored in a locked cabinet, in a locked office, and was only accessed by study researchers.

Infant weight and length were derived from medical records to calculate BMI at the newborn wellness visit and the 4 month wellness visit. BMI at both time points was calculated using the standard BMI formula: weight in kilograms divided by height in meters squared (kg/m^2). Although medical records provided BMI measures, BMI was calculated to ensure precision since medical records provide a rounded numerical value of this index. For H1 hypotheses, birthweight and head circumference were derived from medical records as well as calculated BMI scores were used to calculate a percentile score using the World Health Organization (WHO) Anthro for personal computers, version 3.2.2, 2011: Software for assessing growth (WHO, 2010). These scores are intended to be encompassing and broadly applicable, therefore they do not provide percentile scores for specific ethnic groups. For H2, 4 months weight and head circumference derived from medical records, and calculated BMI were used to calculate a rate of change score between first measure time point (birth or newborn wellness visit) and the 4 month wellness check ((Index value at 4 months-Index value at first measure time point)/Days of Age).

Analytic Approach

Fourteen separate four-block sequential OLS regression models were constructed to test the two study hypotheses. Theoretically relevant and statistically significant sociodemographic and stress-related covariates were controlled in blocks one through three. Scores from the PSS, our general perceived stress measure, and the ARSMA-II (Anglo orientation and Mexican orientation subscales), were included in all analyses as a covariates. Preliminary correlations were run to determine if any demographic variables (maternal age, primary language, place of birth, years in the US, years of education, income, marital status, number of previous deliveries, and maternal BMI) covaried with dependent variables. Any resulting demographic covariates were also included in the corresponding multiple linear regression analyses.

Power Analysis

Multiple linear regressions were the primary analyses of this study. These analyses were used to determine the role of cultural stressors and acculturation level during pregnancy on predicting neonatal health indices at birth, at a newborn wellness visit and at four months. In line with hypotheses, two power analyses were conducted: one for birth outcomes and another for four month outcomes. Ultimately, the power analyses determined that a sample size of 159 was needed to satisfy requirements for all tests and account for 26% attrition.

Power analysis for hypothesis 1. Hypothesis 1 asked whether the cultural stressors of acculturative stress and discrimination stress predicted earlier gestational age, lower birthweight percentile, lower BMI, and smaller head circumference at birth, when controlling for acculturation subscales (increased Anglo Orientation [X3] and decreased Mexican Orientation [X4]) and general perceived stress (X5). For this model, two power analyses were conducted based on a study by D'anna-Hernandez et al. (2012) that found an association between maternal acculturation during pregnancy and the infant indices of gestational age and weight at birth. The outcome of the analysis which yielded the larger sample size was as follows: G*power 3.1 software calculated that a minimum sample of 126 participants would achieve 80% power to detect a small-medium effect when utilizing an F-Test with a significance level (alpha) of 0.05. The use of multiple f^2 of 0.098 of a small-medium effect size for this analysis was justified by a previous study that found a significant negative relationship between maternal acculturation during pregnancy and offspring gestational age at birth (R^2 = .09, p =.03; D'Anna-Hernandez et al., 2012). Due to a 26% attrition rate in our primary study through the birth visit, a final sample size of 159 was determined to be required.

Power analysis for hypothesis 2. Hypothesis 2 required multiple linear regression analyses to determine whether the cultural stressors of acculturative stress (X1) and discrimination stress (X2) and/or two acculturation subscales (increased Anglo Orientation [X3] and decreased Mexican Orientation [X4]) predict increased rate of weight gain rate, BMI gain rate, and head circumference growth rate at 4 months, when controlling for general perceived stress (X5). Work on this has not been done before, therefore, a pilot analyses was conducted to analyze the relationship between our predictors and infant weight trajectory up to their two month regular doctor's visit. For this model, G*power 3.1 software calculated that a minimum sample of 41 participants would achieve 80% power to detect a medium effect when utilizing an F-Test with a significance level (alpha) of 0.05. The use of multiple f^2 of 0.16 of a medium effect size for this analysis is justified by our pilot data analyses on 23 mother-infant pairs, by which we found a significant relationship between Mexican Orientation and infant weight trajectory from birth to the two months of age ($F(1) = .01$, $p = .01$). Due to a 26% attrition rate in our primary study through the birth visit, a final sample size of 52 was determined to be required to satisfy the requirement for the analyses of growth rate at 4 months.

Results

Sample Characteristics

Participants were 92 mother-infant dyads. Mothers ranged in age from 18 to 41 (M = 27.891, SD = 5.188), were primarily Spanish speakers (82.61%) born outside of the US (79.35%), and the majority were either living with (43.48%) or married to (41.3%) the father of their baby. See Table 1 for all sample characteristics (mom age, number of previous deliveries, BMI, place of birth, years in the US, primary language, marital status, income, highest educational attainment). The mean age of infants at the first visit was 4.84 days and at the second visit was 126.51 days (4.16 months).

General Linear Model (GLM) Assumption of Normality

All data were checked for univariate and multivariate normality. An initial kurtosis analysis was conducted for each primary variable to be analyzed. Variable scores with a kurtosis value that fell beyond the ± 1.5 cutoff off were considered to be skewed. Z-scores were calculated for skewed variable values and those values falling beyond ± 2.5 were considered to be outliers. 3 outliers were removed to achieve normality, as determined by kurtosis value, across all variables.

Covariate analyses

Correlation analyses determined that higher maternal pre-pregnancy BMI was associated with higher infant gestational age at birth (r = .284, p = .006), birth weight percentile (r = .366, p = <001), BMI (r = .432, p = <.001), and head circumference (r = .234=8, p = .022) percentiles at a primary care newborn wellness check. Thus, maternal pre-pregnancy BMI was used as a covariate in subsequent analyses of these outcomes. Higher number of previous deliveries (r = −.218, p = .038) was associated with decreased infant BMI change at four months (r = −.224, p = .032) and was included in a subsequent analysis of infant BMI rate of change as a covariate. No other demographic covariates were significantly associated with outcomes of interest. All demographic correlation coefficients are shown in Table 2.

Multiple Linear regressions

Fourteen multiple linear regressions were conducted to investigate hypotheses 1 (H1) and hypothesis 2 (H2). All models included demographic covariates, general perceived stress, Anglo orientation and Mexican orientation scores. Acculturative stress and perceived discrimination were analyzed in separate models.

Cultural Stressors and Birth Outcomes

H1, which stated that increased cultural stressors would be associated with earlier gestational age, as well as decreased weight percentile, BMI percentile and head circumference percentile at birth, was tested using 8 multiple linear regressions.

Gestational age. Two four-block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant gestational age at birth after controlling for relevant covariates. In both regression analyses maternal pre-pregnancy BMI block 1. Block 2 contained general perceived stress and block 3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant gestational age at birth outcome. In the first model, block 4 contained acculturative stress and block 4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant gestational age at birth (ps $\geq .385$). As shown in Tables 3 and 4, greater maternal pre-pregnancy BMI predicted higher gestational age at birth. None of the other covariates in the models were significant predictors of the infant gestational age at birth outcome (ps $\geq .753$).

Birthweight percentile. Two four-block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant weight percentile at birth after controlling for relevant covariates. In both regression analyses block 1 contained maternal pre-pregnancy BMI and infant gestational age at birth. Block 2 contained general perceived stress and block 3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant weight percentile outcome. In the first model, block 4 contained acculturative stress and block 4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant weight percentile at birth (ps $\geq .810$). As shown in Tables 5 and 6, increased gestational age and higher maternal pre-pregnancy BMI predicted higher infant weight percentile at birth. None of the other covariates in the models were significant predictors of the infant weight percentile at birth outcome (*p*s $\geq$ .508).

BMI percentile. Two four block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant BMI percentile at birth after controlling for relevant covariates. In both regression analyses block-1 contained maternal pre-pregnancy BMI and infant gestational age at birth. Block-2 contained general perceived stress and block-3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant BMI percentile outcome. In the first model, block-4 contained acculturative stress and block-4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant BMI percentile at birth (*p*s $\geq$ .446). As shown in Tables 7 and 8, increased gestational age at birth and higher maternal pre-pregnancy BMI predicted higher infant BMI percentile at a newborn wellness check. None of the other covariates in the models were significant predictors of the infant BMI percentile at birth outcome (*p*s $\geq$ .157).

Head circumference percentile. Two four block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant head circumference percentile at a newborn wellness check after controlling for relevant covariates. In both regression analyses block-1 contained maternal pre-pregnancy BMI and infant gestational age at birth. Block-2 contained general perceived stress and block-3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant head circumference percentile outcome. In the first model, block-4 contained acculturative stress and block-4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant head circumference percentile at birth (*p*s $\geq$ .101). As shown in Tables 9 and 10, increased gestational age at birth predicted higher infant head circumference percentile at a newborn wellness check. None of the other covariates in the models were significant predictors of the infant head circumference percentile at birth outcome (*p*s $\geq$ .306).

Cultural Stressors and 4 month Outcomes

H2, which stated that increased cultural stressors would be associated with rapid weight, BMI, and head circumference gain at 4 month, was tested in 6 models.

Change in weight. Two four block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant change in weight at 4 months after controlling for relevant covariates. In both regression analyses block-1 contained infant gestational age at birth and infant age in days at 4 month wellness visit. Block-2 contained general perceived stress and block-3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant change in weight outcome. In the first model, block-4 contained acculturative stress and block-4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant change in weight at 4 months (*p*s $\geq$ .626). As shown in Tables 11 and 12, infant age was the only significant predictor of infant weight change at 4 months. None of the other covariates in the models were significant predictors of the infant change in weight at 4 months outcome (*p*s $\geq$ .293).

Change in BMI. Two four block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant change in BMI at 4 months after controlling for relevant covariates. In both regression analyses block-1 contained infant gestational age at birth, infant age at newborn wellness visit, difference in infant age from newborn wellness visit to 4 month wellness visit, and maternal number of term deliveries. Block-2 contained general perceived stress and block-3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant change in BMI outcome. In the first model, block-4 contained acculturative stress and block-4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant change in BMI at 4 months (ps $\geq .244$). As shown in Tables 13 and 14, increased infant age at newborn wellness visit, greater difference in infant age from newborn wellness visit to 4 month wellness visit, and greater maternal number of term deliveries predicted higher infant change in BMI at 4 months. None of the other covariates in the models were significant predictors of the infant change in BMI at 4 months outcome (ps $\geq .163$).

Change in head circumference. Two four block sequential regressions were conducted to determine the effect of acculturative stress and perceived discrimination stress on infant change in head circumference at 4 months after controlling for relevant covariates. In both regression analyses block-1 contained infant gestational age at birth, infant age at newborn wellness visit, and difference in infant age from newborn wellness visit to 4 month wellness visit. Block-2 contained general perceived stress and block-3 contained Mexican orientation and Anglo orientation. The variables loaded in these first three blocks, were either significant predictors or theoretically relevant predictors of the infant change in head circumference outcome. In the first model, block-4 contained acculturative stress and block-4 contained perceived discrimination stress in the second model. Neither acculturative stress nor perceived discrimination stress were found to predict infant change in head circumference at 4 months (ps $\geq .744$). As shown in Tables 15 and 16, infant gestational age at birth, infant age at newborn wellness visit, and difference in infant age from newborn wellness visit to 4 month wellness visit predicted higher infant change in head circumference at 4 months. None of the other covariates in the models were significant predictors of the infant change in head circumference at 4 months outcome (ps $\geq .349$).

Discussion

People of Mexican descent living in the US exhibit disproportionately high rates of obesity (Committee on Accelerating Progress in Obesity Prevention, 2010; Ogden, Carroll, Kit & Flegal, 2014). Previous research supports the existence of a health decline pattern in US immigrant populations the longer time they have spent in the US, including Mexican Americans (Acevedo, 2000; Masel, Rudkin & Peek, 2006; Gorman & Krueger, 2010). Although the reasons underlying this pattern are not fully understood, researchers have proposed sociocultural stressors that accompany the acculturation process as a mechanism in this occurrence. In line with this, stress early in pregnancy has been associated with adverse infant birth outcomes that are related to later life obesity risk (Dennison, et al., 2006; Pirinçci et al., 2010; Stout et al. 2015). The present study sought to identify the role of fetal exposure to maternal acculturative stress and perceived discrimination stress in predicting infant birth and infancy outcomes related to obesity risk. Acculturative stress and perceived discrimination stress experienced by mothers during pregnancy did not predict infant outcomes at any time point. However, higher maternal pre-pregnancy BMI was shown to positively predict later infant gestational age at birth and increased weight percentile at birth as well as an increased infant BMI percentile. Higher maternal number of previous deliveries was shown to predict lower BMI rate of change at 4 months. These findings suggest that there are enduring effects of prenatal maternal health on infant health outcomes and that researchers ought to be cognizant of these factors for the prenatal care of US women of Mexican descent.

Sociocultural Stressors as Predictors of Infant birthweight and BMI

The present study evaluated the role of sociocultural stressors that often accompany the acculturation process in mothers as predictors of infant outcomes related to lifelong obesity risk. Acculturative stress and perceived discrimination were not associated with infant outcomes related to obesity risk. Previous literature focused on acculturation in US women of Mexican descent has found higher acculturation scores to be associated with lower infant birthweight (Scribner & Dwyer, 2001; Cobas et al., 2001; D'Anna et al., 2012). The present study analyzed birthweight percentile scores rather than birthweight directly in line with previous literature (Stettler et al., 2002). The use of WHO percentile scores allows for combined analyses of males and females, as it accounts for sex, and for interpretation of growth indicators relative to a global population (WHO, 2010). The present study also found no effect of acculturation, via Anglo orientation score, on infant birthweight percentile. It is unclear why our study did not show previous relationships shown between acculturation and birthweight.

There may be various reasons why the presents study does not show an effect of sociocultural stressors on infant outcomes related to obesity risk. Our sample may have been limited in capturing acculturative stress effects given that on average participants reported lower acculturative stress scores than previous studies that have analyzed the effects of acculturative stress on health outcomes (Hovey & King, 1996; Hovey & Magaña, 2002; Perez, Voelz, Pettit & Joiner, 2002). The mean SAFE score in the present study was 25.02, compared to 30.48, 52.5, and 56.2 in other studies. Alternatively, the SAFE scale may not have been the most effective in capturing acculturative stress factors that are most salient to Mexican American women during pregnancy. Higher scores on the SAFE are primarily driven by perceived discrimination stress (Mena et al., 1987). Therefore, it is possible that the present study primarily assessed potential effects of perceived discrimination stress –though perceived discrimination stress was not found to be associated with infant outcomes related to obesity risk. Perceived discrimination scores among the present study's sample were also low. The mean was 1.5 and the range of scores was 1 to 2.5 on a 1 to 4 scale. However, it is also possible that there are other sociocultural stress factors that are more relevant to pregnant Mexican American women during pregnancy that are not captured by any existing acculturative stress scales. Perhaps expectations about pregnancy, the ability to carry out traditional cultural practices during this important period of life, expectations about care providers and/or settings, familial other cultural factors may be more applicable. Some literature suggest that being understood by providers and a communication that feels as though it is between friends is important to Mexican origin pregnant women (Baxley & Ibitayo, 2015). It may be important to further explore pregnancy specific sociocultural stressors in future studies. Still, literature supports a link between acculturation and obesity risk (Espinosa de los Monteros, Gallo, Elder, & Talavera, 2008; Vella, Ontiveros, & Bader, 2011). Another facet to consider in why this relationship was not supported by the present study is that mothers in the present study adhered more to Mexican orientation (*M* = 4.17, *SD* = .507) and less so to Anglo orientation (*M* = 2.644, *SD* = .973). Some literature has shown that increased adherence to Mexican cultural values to be protective when facing adversity (Delgado et al., 2011), to encourage help seeking behaviors (Ramos-Sánchez & Atkinson, 2009), and to buffer negative mental health outcomes (Tynes et al., 2012; Zeiders, 2013). Therefore, it may be necessary to consider cultural values as mechanisms, perhaps as a potential buffer, in the relationship between acculturation and obesity risk in US Mexican origin population. The acculturation process has been suggested to be slower amongst Mexican-Americans than other immigrant groups. This is due to proximity to Mexico, availability of Spanish media and the large ongoing stream of persons who come to the US, which all support the Mexican cultural experience in the US (Fry 2009; Lopez 2009). Further, research has suggested that there may be distinct Mexican origin subgroups within the US and that their risk for experiencing certain types of stress and outcomes related to stress may differ based on regional and general social climate (Cervantes & Castro, 1985; Otiniano Verissimo, Grella, Amaro & Gee, 2014; Salvador-Moysén et al., 2014). Participants of the present study were mostly Spanish speakers born in Mexico and residents of a California/Mexico border county that is highly Latino populated proximity to the US/Mexico border. It is possible that there was a restriction of range in acculturation status in the sampled population. Future studies should include other Mexican populations with varying distance from the border. More research is necessary to determine the role of cultural factors in obesity related outcomes during pregnancy among the Mexican descent US population.

Maternal Health Factors in Infant birthweight and BMI Risk

The Prenatal Programming Hypothesis (Barker, 2004) states that the maternal environment, including health, during pregnancy affects offspring health outcomes. This theory is supported by research that shows maternal nutrition (Wu, Cudd, Meininger & Spencer, 2004; Abu-Saad & Fraser, 2010), and mental health factors, such as stress, anxiety, and depression (Beijers, Jansen, Riksen-Walraven & de Weerth, 2010; Buss, Entringer, Swanson & Wadhwa, 2012; Conde et al.,2010) predict infant outcomes related to development and illness. Further, adverse birth outcomes, preterm birth and low birthweight, are associated with lifelong health implications (Barker et al. 1989; Frankel et al., 1996; Hua et al., 2016). In the present study maternal BMI was shown to positively predict infant health indices related to obesity – gestational age, birthweight percentile, and BMI percentile at a newborn wellness visit. The implications of these findings are mixed, given that later gestational age at birth is a favorable infant outcome (Goldenberg et al., 2008), but infant weight and BMI that is very high at birth may be risk factors for adverse outcomes related to obesity (Boney, Verma, Tucker, & Vohr, 2005). Being born small has been associated with catch-up growth, a growth compensation process that is associated with increased abdominal adiposity and adipose related diseases (Sullivan, et al., 2008). Therefore, greater maternal pre-pregnancy BMI may be a protective factor against birth outcomes related to obesity. However, maternal BMI that is too high can also give way to health risk in offspring (Espel et al., 2014; Spong, 2013; Zhang & Kramer, 2009). Furthermore, high maternal BMI has been shown to predict increased rates of adverse maternal and infant outcomes such as gestational diabetes mellitus, proteinuric pre-eclampsia, delivery by emergency caesarian section, postpartum hemorrhage, birthweight above the 90th percentile, and intrauterine death (Sebire et al., 2001; Baeten, Bukusi & Lambe, 2001; Cedergren, 2004; Johansson, Villamor, Altman, Bonamy, Granath & Cnattingius, 2014). Therefore, understanding elements that contribute to obesity risk in women of Mexican descent prior to pregnancy may be a means by which to address obesity risk in this population. In addition, some research suggests that distinct dietary and physical exercise practices are exhibited by people of Mexican descent in the US depending on factors such as acculturation, generational, and socioeconomic status (Hernandez-Barrera et al., 2011; Creighton, Goldman, Pebley & Chung, 2012; Johansson et al., 2014; Yoshida et al. 2017). Therefore, factors, cultural and/or otherwise, that impact lifestyle and maternal BMI may also be important in understanding lifelong obesity risk of infants of Mexican descent. Taken together, our work demonstrates pre-pregnancy maternal BMI as an important factor that contributes to the programming of early life indices of obesity and health.

The present study also found maternal number of previous deliveries to be associated with infant outcomes. Increased maternal number of previous deliveries was shown to predict a slower rate of change in BMI at 4 months. Research on the impact of maternal number of previous deliveries on offspring BMI outcomes remains mixed. During childhood, various studies have shown only children or last-born children to be at increased risk of being overweight and/or obese (Ochiai et al., 2012; Haugaard, Ajslev, Zimmermann, Ängquist, & Sørensen, 2013; Chen & Escarce, 2014). These studies also support a relationship between greater number of siblings and lower obesity risk (Ochiai et al., 2012; Haugaard et al. 2013; Chen & Escarce, 2014; Datar, A. 2017). However, another study found increased maternal BMI during pregnancy and number of previous deliveries to predict greater offspring waist circumference and BMI at age 30, independent of current lifestyle factors (Reynolds, Osmond, Phillips, & Godfrey, 2010). The present study found increased maternal number of previous deliveries (more pregnancies) to predict a slower rate of BMI change from days after birth to 4 months of age and not BMI directly. Previous studies that have looked at the relationship between rapid weight gain in infancy and overweight in childhood as well as in adulthood have included maternal parity in multivariate analyses (Demerath et al., 2012 ; Zhou et al., 2016). However, these studies did not report the direct effect of maternal number of previous deliveries on rapid weight gain. A review of the literature suggest that the present study is the first to report the relationship between increased number of previous deliveries and slower offspring weight gain rate at 4 months. Multiple studies have shown rapid BMI change during infancy to be a risk factor for later life obesity. This includes during childhood (Goodell, Wakefield & Ferris, 2009; Min, Li, J., Li, Z. & Wang, 2012; Taveras, Rifas-Shiman, Belfort, Kleinman, Oken, & Gillman, 2009) as well as late adolescence (Thorén, Werner, Lundholm, Bråbäck & Silfverdal, 2015). Therefore, our study may indicate that being a later-born child to be a protective factor in obesity risk. Further, our finding supports the former literature in showing that maternal number of previous deliveries has an enduring relationship with infant BMI trajectory. The present study's finding of higher number of previous deliveries predicting a slower BMI change over time may indicate a need for consideration of maternal number of previous deliveries in offspring obesity risk and growth outcomes and differential attention in care based on pregnancy number. However, more research is needed to determine the potential implications of this finding. Moreover, the present findings of an effect of maternal BMI and number of previous deliveries as predictors of infant birth outcomes support a multidimensional approach in addressing the US Mexican descent population's perinatal health needs and perinatal obesity risk factors.

Maternal BMI and Birth Outcomes related to Obesity Risk

The present study found maternal BMI to be an important predictor of infant birth outcomes related to obesity risk. Given that birth outcomes are crucial to lifelong disease and obesity risk, further discussion is warranted. Previous literature has shown earlier gestational age, even that falling within the full-term 37-41 weeks gestation period, to be a lifelong risk factor for health problems in offspring. In the present study greater maternal BMI was found to predict greater gestational age at birth. This finding supports previous literature that indicate increased maternal pre-pregnancy BMI as a protective factor in the gestational age outcome

(Hendler et al., 2005; Goldenberg et al., 2008). The present study also found pre-pregnancy BMI to predict infant size indices of weight percentile at birth and BMI percentile at a newborn wellness visit. Research has shown higher propensity for coronary heart disease and its risk factors in LBW infants, including increased blood pressure in childhood and higher resting heart rate in adulthood (Barker et al. 1989; Frankel et al., 1996; Hua et al., 2016). Catch-up growth and rapid weight gain resulting from LBW are mechanisms believed to underlie such effects. Therefore, increased maternal BMI may be a protective factor against these adverse growth patterns associated with lifelong obesity risk in infants born small (Latal-Hajnal et al., 2003). However, while maternal pre-pregnancy BMI may protect against catch-up growth across these indices, maternal BMI that is too high is a risk factor for adverse offspring health at birth (Sebire et al., 2001; Baeten, Bukusi & Lambe, 2001; Cedergren, 2004; Johansson, Villamor, Altman, Bonamy, Granath & Cnattingius, 2014) and childhood (Boney, Verma, Tucker, & Vohr, 2005). Further research needs to be done to identify the unique risk of obesity related outcomes associated with gestational age, weight percentile at birth, and newborn BMI percentile in Mexican American offspring.

In the present study maternal pre-pregnancy BMI was shown to predict the newborn outcomes of infant gestational age and increased weight percentile at birth as well as increased infant BMI percentile at a newborn wellness visit, but not infant head circumference at a newborn wellness visit. Although head circumference at birth has been associated with earlier timing of adiposity rebound, the age in childhood when BMI is at its lowest before increasing again (Erikkson et al. 2014), literature linking head circumference to adiposity is limited. It is possible that previous literature that showed a relationship between head circumference and BMI trajectory was actually capturing an effect of catch-up growth, the body’s natural growth compensation process exhibited by infants that are small at birth (Tanner, 1994; Latal-Hajnal et al., 2003). Specifically, with head circumference as an index of size and catch-up growth trajectory. The potential implications of head circumference in obesity risk as well as the potential role of maternal health factors in predicting this outcome require further investigation.

Strengths and limitations

The present study had several strengths as well as limitations. The present study benefitted from access to participants at their regular OB care setting, which likely reduced potential participant fatigue as well as attrition. A foremost strength of this study was the use of multidimensional measures in assessing acculturation and its related sociocultural stressors. Much of the acculturation literature is limited by the use of proxies for acculturation such as: years in the US, place of birth, and/or primary language. These proxies do not capture individual experiences and sentiments in adhering to Mexican and/or mainstream Anglo culture. The present study used the ARSMA (Cuellar et al., 1995), an acculturation measure designed specifically for use in people of Mexican descent. Further, this measure’s composition of an Anglo orientation and Mexican orientation subscale allowed statistical analyses to delineate relative effects of adherence to each culture. Despite being multidimensional, the ARSMA is highly language preference focused and this is a potential limitation of out study. The present study’s use of the SAFE to assess acculturative stress was a strength for its multidimensional approach as well as its previous validation among Latino populations and people of Mexican descent specifically (Fuertes & Westbrook, 1996; Hovey, 2000). However, high scores on this scale have been shown to be driven by perceived discrimination stress (Mena et al., 1987). The present study would have benefitted from the use of an additional acculturative stress scale. The use of the DSS to assess perceived discrimination was also a strength of this study as it specifically addresses perceived racial and ethnic discrimination and has been validated for use in Mexican adults (Flores et al., 2010) and pregnant women of Mexican descent (Preciado & D'Anna-Hernandez, 2016). The present study was also strengthened by its analyses of various demographic factors that have been shown to impact health outcomes, such income and years in the US, and inclusion of maternal general perceived stress in all primary analyses. Moreover, the administration of all measures in English or Spanish, per participant preference, and an all English/Spanish bilingual research staff were a benefit to this study. However, the high prevalence of Spanish speakers in our sample may have been a weakness of the present study. The majority of participants were primarily Spanish speakers, born outside of the US, and very low income. In addition to limiting our ability to capture differences within in our sample, this constitutes a need for caution in the interpretation and application of our results. As previously mentioned, our samples' close proximity to the country of origin and opportunity for slower acculturation process may also make our sample distinct from other similar groups and this may also be a limitation of our study.

The longitudinal design of this study was also beneficial. While infant medical release forms were necessarily collected post-partum, the collection of stress and acculturation measures in early pregnancy was essential to capturing maternal experience during the stress-sensitive early pregnancy period. In addition, the use of a longitudinal design allowed for the analyses of obesity-risk outcomes at two time points and ultimately revealed differential associations between outcomes of interest and maternal demographics as well covariate factors.

The use of medical records to assess physical outcomes had advantages and disadvantages. Medical records allowed the acquisition of measures taken by medical professionals and for more precision than could have been achieved with self-reported measures from participants. However, the use of medical records did not allow measures to be taken at precise time points. Specifically, the time of collection of maternal pre-pregnancy height and weight measures (used to calculate BMI) likely ranged in proximity to the initial prenatal OB visit. In regards to infant outcomes, although the infant 4 month visit is termed so, mothers have the option to schedule the visit in the days before or following the time point. Further, if they missed their appointment data attainment was further delayed. Although the present study controlled for infant gestational age at birth, as well as age at first visit, and age difference at the second time point, more accurate data may have been acquired if measures were collected at exact time points. Further, although efforts were made to attain all data required via medical records, due to infant medical record acquisition challenges, a primary limitation of this study was a reduced sample size.

Medical records were acquired for mothers at a regular OB visit and for infants at an in-home visit within 2 weeks of delivery. Medical records were attained when the infant was 5-months old in order to assure that the 4 month infant care visit would be included in the record. This extra month allowed for the data of infants whose mothers scheduled their 4 month visit shortly after they turned 4 months old to be included in the data analyses. However, likely due to human error, some records did not include all infant indices required to be noted at the visit. In addition, some infant were transferred to other clinics for their primary care and the study no longer had medical record access. One of two power analyses based on a previous study that found an association between maternal sociocultural stressors and infant outcomes at birth determined that a sample size of 126 was needed to detect a small-medium effect. Our study achieved a sample size of 92. This necessitates caution in interpreting results. Still, this study is an important step in understanding the obesity health disparity that afflicts the Mexican origin population in the US.

Future directions

The present study found maternal pre-pregnancy BMI to be associated with infant gestational age at birth and increased weight percentile at birth as well as increased infant BMI percentile at a newborn wellness visit. Some research has considered increased maternal BMI to be a protective factor against adverse infant birth outcomes. However, it is important for further research to identify the optimal maternal BMI for potentiating favorable infant outcomes and not adverse BMI related outcomes in Mexican Americans. Further, these findings suggest that in addition to considering the physical and mental health of mothers during the perinatal period as predictors of infant outcomes associated with obesity risk, maternal health, number of previous deliveries, and wellbeing prior to pregnancy also requires attention. In addition, more research is needed to determine the extent to which cultural factors may play a role in maternal health prior to and during pregnancy. Research is also needed to determine the best timing to begin care that accompanies family planning as well as care methods that can be implemented in the case of unplanned pregnancy in this population to improve maternal wellbeing and reduce obesity risk outcomes in offspring. Further, although our study did not find an association between cultural stressors in mothers and infant outcomes, more investigation on this topic is necessary. It is possible that geographic location factors (e.g. culture of origin influences in current living location, access to support systems, etc.) affected the acculturation process or buffered the effects of sociocultural stressors. Alternatively, other stressors, such as quality of communication with providers may be a more pertinent source of stress during pregnancy in this population. More research needs to be conducted to uncover these relevant factors and how they affect maternal as well as infant well-being and obesity risk.

Conclusions

The present study sought to understand the role of sociocultural stressors experienced by mothers early in pregnancy on obesity risk factors of their offspring. Although neither acculturative stress nor perceived discrimination were shown to predict infant outcomes related to later life obesity risk, maternal BMI and number of previous deliveries were found to be salient factors. The present study provides evidence for an effect of maternal health on offspring outcomes. Still, more work is needed to understand the degree to which maternal BMI and number of previous deliveries and risk and/or protective factor in Mexican American offspring obesity risk. Further research is needed to determine the potential role of cultural adaptation factors in the relationship between maternal health and infant lifelong obesity risk and to address the pervasive obesity disparity faced by the Mexican origin population.

References

Abu-Saad, K., & Fraser, D. (2010). Maternal nutrition and birth outcomes. Epidemiologic reviews, 32(1), 5-25.

Acevedo, M. C. (2000). The role of acculturation in explaining ethnic differences in the prenatal health-risk behaviors, mental health, and parenting beliefs of Mexican American and European American at-risk women. Child Abuse & Neglect, 24(1), 111–127. https://doi.org/10.1016/S0145-2134(99)00121-0

Acevedo-Garcia, D., Soobader, M.-J., & Berkman, L. F. (2007). Low birthweight among US Hispanic/Latino subgroups: The effect of maternal foreign-born status and education. Social Science & Medicine, 65(12), 2503–2516. https://doi.org/10.1016/j.socscimed.2007.06.033

Allport, G. W. (1979). The Nature Of Prejudice. Basic Books.

Baeten, J. M., Bukusi, E. A., & Lambe, M. (2001). Pregnancy complications and outcomes among overweight and obese nulliparous women. American journal of public health, 91(3), 436.

Barker, D. J. P. (2004). The developmental origins of adult disease. Journal of the American College of Nutrition, 23(sup6), 588S-595S.

Barker, D. J., Bagby, S. P., & Hanson, M. A. (2006). Mechanisms of disease: in utero programming in the pathogenesis of hypertension. Nature Reviews Nephrology, 2(12), 700.

Basten, M., Jaekel, J., Johnson, S., Gilmore, C., & Wolke, D. (2015). Preterm Birth and Adult Wealth: Mathematics Skills Count. Psychological Science, 26(10), 1608–1619. https://doi.org/10.1177/0956797615596230

Batis, C., Hernandez-Barrera, L., Barquera, S., Rivera, J. A., & Popkin, B. M. (2011). Food Acculturation Drives Dietary Differences among Mexicans, Mexican Americans, and Non-Hispanic Whites–3. The Journal of nutrition, 141(10), 1898-1906.

Baxley, S. M., & Ibitayo, K. (2015). Expectations of pregnant women of Mexican origin regarding their health care providers. Journal of Obstetric, Gynecologic, & Neonatal Nursing, 44(3), 389-396.

Behrman, R. E., & Butler, A. S. (2007). Committee on understanding premature birth and assuring healthy outcomes. Preterm birth: causes, consequences, and prevention. National Academy of Sciences.

Beijers, R., Jansen, J., Riksen-Walraven, M., & de Weerth, C. (2010). Maternal prenatal anxiety and stress predict infant illnesses and health complaints. Pediatrics, peds-2009.

Benet-Martínez, V., Leu, J., Lee, F., & Morris, M. W. (2002). Negotiating Biculturalism: Cultural Frame Switching in Biculturals with Oppositional Versus Compatible Cultural Identities. Journal of Cross-Cultural Psychology, 33(5), 492–516. https://doi.org/10.1177/0022022102033005005

Berry, J. W. (2005). Acculturation: Living successfully in two cultures. International Journal of Intercultural Relations, 29(6), 697–712. https://doi.org/10.1016/j.ijintrel.2005.07.013

Boney, C. M., Verma, A., Tucker, R., & Vohr, B. R. (2005). Metabolic syndrome in childhood: association with birth weight, maternal obesity, and gestational diabetes mellitus. Pediatrics, 115(3), e290-e296.

Braveman, P., & Gottlieb, L. (2014). The Social Determinants of Health: It's Time to Consider the Causes of the Causes. Public Health Reports, 129(1_suppl2), 19–31. https://doi.org/10.1177/00333549141291S206

Buss, C., Entringer, S., Swanson, J., & Wadhwa, P. (2012). The role of stress in brain development: The gestational environment's long-term effects on the brain. Cerebrum.

Cachelin, F. M., Phinney, J. S., Schug, R. A., & Striegel-Moore, R. H. (2006). Acculturation and Eating Disorders in a Mexican American Community Sample. Psychology of Women Quarterly, 30(4), 340–347. https://doi.org/10.1111/j.1471-6402.2006.00309.x

Camacho, A. (2008). Stress and Birth Weight: Evidence from Terrorist Attacks. American Economic Review, 98(2), 511–515. https://doi.org/10.1257/aer.98.2.511

Campbell, K., Garcia, D. M., Granillo, C. V., & Chavez, D. V. (2012). Exploring the Latino Paradox: How Economic and Citizenship Status Impact Health. Hispanic Journal of Behavioral Sciences, 34(2), 187–207. https://doi.org/10.1177/0739986312437552

Campos, B., Schetter, C. D., Walsh, J. A., & Schenker, M. (2007). Sharpening the Focus on Acculturative Change: ARSMA-II, Stress, Pregnancy Anxiety, and Infant Birthweight in Recently Immigrated Latinas. Hispanic Journal of Behavioral Sciences, 29(2), 209–224. https://doi.org/10.1177/0739986307300841

Canady, R. B., Stommel, M., & Holzman, C. (2009). Measurement Properties of the Centers for Epidemiological Studies Depression Scale (CES-D) in a Sample of African American and Non-Hispanic White Pregnant Women. Journal of Nursing Measurement, 17(2), 91–104. https://doi.org/10.1891/1061-3749.17.2.91

Carrera, Gao, & Tucker. (2007). A Study of Dietary Patterns in the Mexican-American Population and Their Association with Obesity. Journal of the American Dietetic Association, 107(10), 1735-1742.

Catch-up growth in small for gestational age babies: good or... : Current Opinion in Endocrinology, Diabetes and Obesity. (n.d.). Retrieved April 18, 2017, from http://journals.lww.com/co-endocrinology/Fulltext/2007/02000/Catch_up_growth_in_small_for_gestational_age.7.aspx

Cedergren, M. I. (2004). Maternal morbid obesity and the risk of adverse pregnancy outcome. Obstetrics & Gynecology, 103(2), 219-224.

Cervantes, R. C., & Castro, F. G. (1985). Stress, coping, and Mexican American mental health: A systematic review. Hispanic Journal of Behavioral Sciences, 7(1), 1-73.

Chen, A. Y., & Escarce, J. J. (2014). Family structure and childhood obesity: an analysis through 8th grade. Maternal and child health journal, 18(7), 1772-1777.

Chun, K. M., Balls Organista, P. E., & Marín, G. E. (2003). Acculturation: Advances in theory, measurement, and applied research. (2003) (Vol. xxvii). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/10472-000

Cobas, J. A., Balcazar, H., Benin, M. B., Keith, V. M., & Chong, Y. (1996). Acculturation and low-birthweight infants among Latino women: a reanalysis of HHANES data with structural equation models. American journal of public health, 86(3), 394-396.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A Global Measure of Perceived Stress. Journal of Health and Social Behavior, 24(4), 385–396. https://doi.org/10.2307/2136404

Collins, J. W., David, R. J., Symons, R., Handler, A., Wall, S. N., & Dwyer, L. (2000). Low-Income African-American Mothers’ Perception of Exposure to Racial Discrimination and Infant Birth Weight. Epidemiology, 11(3), 337–339.

Committee on Accelerating Progress in Obesity Prevention (2012). Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation. National Academies Press.

Conde, A., Figueiredo, B., Tendais, I., Teixeira, C., Costa, R., Pacheco, A., ... & Nogueira, R. (2010). Mother's anxiety and depression and associated risk factors during early pregnancy: effects on fetal growth and activity at 20–22 weeks of gestation. Journal of Psychosomatic Obstetrics & Gynecology, 31(2), 70-82.

Copper, R. L., Goldenberg, R. L., Das, A., Elder, N., Swain, M., Norman, G., ... & Jones, P. (1996). The preterm prediction study: Maternal stress is associated with spontaneous preterm birth at less than thirty-five weeks' gestation. American Journal of Obstetrics & Gynecology, 175(5), 1286-1292.

Creighton, M. J., Goldman, N., Pebley, A. R., & Chung, C. Y. (2012). Durational and generational differences in Mexican immigrant obesity: is acculturation the explanation?. Social Science & Medicine, 75(2), 300-310.

Cuellar, I., Arnold, B., & Maldonado, R. (1995). Acculturation Rating Scale for Mexican Americans-II: A Revision of the Original ARSMA Scale. Hispanic Journal of Behavioral Sciences, 17(3), 275–304. https://doi.org/10.1177/07399863950173001

D'Anna, K. L., Hoffman, M. C., Zerbe, G. O., Coussons-Read, M., Ross, R. G., & Laudenslager, M. L. (2012). Acculturation, maternal cortisol and birth outcomes in women of Mexican descent. Psychosomatic Medicine, 74(3), 296–304. https://doi.org/10.1097/PSY.0b013e318244fbde

D'Anna-Hernandez, K. L., Aleman, B., & Flores, A.-M. (2015). Acculturative stress negatively impacts maternal depressive symptoms in Mexican-American women during pregnancy. Journal of Affective Disorders, 176, 35–42. https://doi.org/10.1016/j.jad.2015.01.036

Datar, A. (2017). The more the heavier? Family size and childhood obesity in the US. Social Science & Medicine, 180, 143-151.

Delgado, Melissa Y., Updegraff, Kimberly A., Roosa, Mark W., & Umana-Taylor, Adriana J. (2011). Discrimination and Mexican-Origin Adolescents' Adjustment: The Moderating Roles of Adolescents', Mothers', and Fathers' Cultural Orientations and Values. Journal of Youth and Adolescence, 40(2), 125-139.

Demerath, E. W., Reed, D., Choh, A. C., Soloway, L., Lee, M., Czerwinski, S. A., ... & Towne, B. (2009). Rapid postnatal weight gain and visceral adiposity in adulthood: the Fels Longitudinal Study. Obesity, 17(11), 2060-2066.

Dennison, B. A., Edmunds, L. S., Stratton, H. H., & Pruzek, R. M. (2006). Rapid infant weight gain predicts childhood overweight. Obesity, 14(3), 491-499.

Drake, A. J., & Reynolds, R. M. (2010). Impact of maternal obesity on offspring obesity and cardiometabolic disease risk. Reproduction, 140(3), 387-398.

Driscoll, M. W., & Torres, L. (2013). Acculturative stress and Latino depression: The mediating role of behavioral and cognitive resources. Cultural Diversity and Ethnic Minority Psychology, 19(4), 373–382. https://doi.org/10.1037/a0032821

Earnshaw, V. A., Rosenthal, L., Lewis, J. B., Stasko, E. C., Tobin, J. N., Lewis, T. T., … Ickovics, J. R. (2013). Maternal Experiences with Everyday Discrimination and Infant Birth Weight: A Test of Mediators and Moderators Among Young, Urban Women of Color. Annals of Behavioral Medicine, 45(1), 13–23. https://doi.org/10.1007/s12160-012-9404-3

Ekelund, U., Ong, K. K., Linné, Y., Neovius, M., Brage, S., Dunger, D. B., Wareham, N.J. & Rössner, S. (2007). Association of weight gain in infancy and early childhood with metabolic risk in young adults. The Journal of Clinical Endocrinology & Metabolism, 92(1), 98-103.

Elder, J. P., Broyles, S. L., Brennan, J. J., Nuncio, M. L. Z. de, & Nader, P. R. (2005). Acculturation, Parent–Child Acculturation Differential, and Chronic Disease Risk Factors in a Mexican-American Population. Journal of Immigrant Health, 7(1), 1–9. https://doi.org/10.1007/s10903-005-1385-x

Eriksson, J. G., Kajantie, E., Lampl, M., Osmond, C., & Barker, D. J. P. (2014). Small head circumference at birth and early age at adiposity rebound. Acta Physiologica, 210(1), 154–160. https://doi.org/10.1111/apha.12142

Ertel, K. A., James-Todd, T., Kleinman, K., Krieger, N., Gillman, M., Wright, R., & Rich-Edwards, J. (2012). Racial discrimination, response to unfair treatment, and depressive symptoms among pregnant black and African American women in the United States. Annals of Epidemiology, 22(12), 840–846. https://doi.org/10.1016/j.annepidem.2012.10.001

Espel, E. V., Glynn, L. M., Sandman, C. A., & Davis, E. P. (2014). Longer Gestation among Children Born Full Term Influences Cognitive and Motor Development. PLOS ONE, 9(11), e113758. https://doi.org/10.1371/journal.pone.0113758

Espinosa de los Monteros, K., Gallo, L. C., Elder, J. P., & Talavera, G. A. (2008). Individual and area-based indicators of acculturation and the metabolic syndrome among low-income Mexican

Fawke, J. (2007). Neurological outcomes following preterm birth. Seminars in Fetal and Neonatal Medicine, 12(5), 374–382. https://doi.org/10.1016/j.siny.2007.06.002

Feagin, J. R., & Eckberg, D. L. (1980). Discrimination: Motivation, Action, Effects, and Context. Annual Review of Sociology, 6(1), 1–20. https://doi.org/10.1146/annurev.so.06.080180.000245

Finch, B. K., Hummer, R. A., Kol, B., & Vega, W. A. (2001). The Role of Discrimination and Acculturative Stress in the Physical Health of Mexican-Origin Adults. Hispanic Journal of Behavioral Sciences, 23(4), 399–429. https://doi.org/10.1177/0739986301234004

Flores, E., Tschann, J. M., Dimas, J. M., Bachen, E. A., Pasch, L. A., & de Groat, C. L. (2008). Perceived Discrimination, Perceived Stress, and Mental and Physical Health Among Mexican-Origin Adults. Hispanic Journal of Behavioral Sciences, 30(4), 401–424. https://doi.org/10.1177/0739986308323056

Frankel, S., Elwood, P., Smith, G. D., Sweetnam, P., & Yarnell, J. (1996). Birthweight, body-mass index in middle age, and incident coronary heart disease. The Lancet, 348(9040), 1478–1480. https://doi.org/10.1016/S0140-6736(96)03482-4

Fry, R., The Changing Pathways of Hispanic Youths Into Adulthood, 2009, Washington, DC: Pew Hispanic Center

Fuertes, J. N., & Westbrook, F. D. (1996). Using the Social, Attitudinal, Familial, and Environmental (S.A.F.E.) Acculturation Stress Scale to assess the adjustment needs of Hispanic college students. Measurement and Evaluation in Counseling and Development, 29(2), 67–76.

Gallagher-Thompson, D., Shurgot, G. R., Rider, K., Gray, H. L., McKibbin, C. L., Kraemer, H. C., … Thompson, L. W. (2006). Ethnicity, Stress, and Cortisol Function in Hispanic and Non-Hispanic White Women: A Preliminary Study of Family Dementia Caregivers and Noncaregivers. The American Journal of Geriatric Psychiatry, 14(4), 334–342. https://doi.org/10.1097/01.JGP.0000206485.73618.87

Gianaros, P. J., & Wager, T. D. (2015). Brain-Body Pathways Linking Psychological Stress and Physical Health. Current Directions in Psychological Science, 24(4), 313–321. https://doi.org/10.1177/0963721415581476

Gluckman, P. D., Hanson, M. A., Cooper, C., & Thornburg, K. L. (2008). Effect of In Utero and Early-Life Conditions on Adult Health and Disease. New England Journal of Medicine, 359(1), 61–73. https://doi.org/10.1056/NEJMra0708473

Glynn, L. M., Wadhwa, P. D., Dunkel-Schetter, C., Chicz-DeMet, A., & Sandman, C. A. (2001). When stress happens matters: Effects of earthquake timing on stress responsivity in pregnancy. American Journal of Obstetrics and Gynecology, 184(4), 637–642. https://doi.org/10.1067/mob.2001.111066

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. The lancet, 371(9606), 75-84.

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. The Lancet, 371(9606), 75–84. https://doi.org/10.1016/S0140-6736(08)60074-4

Gonzales, N. A., Germán, M., Kim, S. Y., George, P., Fabrett, F. C., Millsap, R., & Dumka, L. E. (2008). Mexican American Adolescents’ Cultural Orientation, Externalizing Behavior and Academic Engagement: The Role of Traditional Cultural Values. American Journal of Community Psychology, 41(1–2), 151–164. https://doi.org/10.1007/s10464-007-9152-x

Gonzalez-Barrera A, Lopez M: A demographic portrait of Mexican-origin Hispanics in the United States. Washington, D.C.: Pew Hispanic Center, 2013.

Goodell, L. S., Wakefield, D. B., & Ferris, A. M. (2009). Rapid weight gain during the first year of life predicts obesity in 2–3 year olds from a low-income, minority population. Journal of community health, 34(5), 370-375.

Gorman, B. K., Read, J. G., & Krueger, P. M. (2010). Gender, Acculturation, and Health among Mexican Americans. Journal of Health and Social Behavior, 51(4), 440–457. https://doi.org/10.1177/0022146510386792

Haritatos, J., & Benet-Martínez, V. (2002). Bicultural identities: The interface of cultural, personality, and socio-cognitive processes. Journal of Research in Personality, 36(6), 598–606. https://doi.org/10.1016/S0092-6566(02)00510-X

Harris, R., Tobias, M., Jeffreys, M., Waldegrave, K., Karlsen, S., & Nazroo, J. (2006). Effects of self-reported racial discrimination and deprivation on Māori health and inequalities in New Zealand: cross-sectional study. The Lancet, 367(9527), 2005–2009. https://doi.org/10.1016/S0140-6736(06)68890-9

Haugaard, L. K., Ajslev, T. A., Zimmermann, E., Ängquist, L., & Haugaard, L. K., Ajslev, T. A., Zimmermann, E., Ängquist, L., & Sørensen, T. I. (2013). Being an only or last-born child increases later risk of obesity. PLoS One, 8(2), e56357.

Heilemann, M., Frutos, L., Lee, K., & Kury, F. S. (2004). Protective Strength Factors, Resources, and Risks in Relation to Depressive Symptoms Among Childbearing Women of Mexican Descent. Health Care for Women International, 25(1), 88–106. https://doi.org/10.1080/07399330490253265

Hendler, I., Goldenberg, R. L., Mercer, B. M., Iams, J. D., Meis, P. J., Moawad, A. H., ... & Thurnau, G. R. (2005). The Preterm Prediction Study: association between maternal body mass index and spontaneous and indicated preterm birth. American Journal of Obstetrics & Gynecology, 192(3), 882-886.

Hovey, J. D., & King, C. A. (1996). Acculturative Stress, Depression, and Suicidal Ideation among Immigrant and Second-Generation Latino Adolescents. Journal of the American Academy of Child & Adolescent Psychiatry, 35(9), 1183–1192. https://doi.org/10.1097/00004583-199609000-00016

Hovi, P., Andersson, S., Järvenpää, A.-L., Eriksson, J. G., Strang-Karlsson, S., Kajantie, E., & Mäkitie, O. (2009). Decreased Bone Mineral Density in Adults Born with Very Low Birth Weight: A Cohort Study. PLOS Medicine, 6(8), e1000135. https://doi.org/10.1371/journal.pmed.1000135

Hua, Y., Wang, F., Zhang, T., Zhang, H., Chen, W., Shen, W., … Li, S. (2016). Relation of Birth Weight to Heart Rate in Childhood, Adolescence, and Adulthood (from the Bogalusa Heart Study). The American Journal of Cardiology, 118(6), 828–832. https://doi.org/10.1016/j.amjcard.2016.06.046

Hughes, A. R., Sherriff, A., Lawlor, D. A., Ness, A. R., & Reilly, J. J. (2013, May). Early Adiposity Rebound Increases Risk Of Obesity In Adolescence. In MEDICINE AND SCIENCE IN SPORTS AND EXERCISE (Vol. 45, No. 5, pp. 270-270). 530 WALNUT ST, PHILADELPHIA, PA 19106-3621 USA: LIPPINCOTT WILLIAMS & WILKINS.

Johansson, S., Villamor, E., Altman, M., Bonamy, A. K. E., Granath, F., & Cnattingius, S. (2014). Maternal overweight and obesity in early pregnancy and risk of infant mortality: a population based cohort study in Sweden. Bmj, 349, g6572.

Johnson, R. C., & Schoeni, R. F. (2011). Early-Life Origins of Adult Disease: National Longitudinal Population-Based Study of the United States. American Journal of Public Health, 101(12), 2317–2324. https://doi.org/10.2105/AJPH.2011.300252

Johnson-Motoyama, M. (2014). Does a paradox exist in child well-being risks among foreign-born Latinos, U.S.-born Latinos, and Whites? Findings from 50 California cities. Child Abuse & Neglect, 38(6), 1061–1072. https://doi.org/10.1016/j.chiabu.2013.09.011

Jones ME, & Bond ML. (1999). Predictors of birth outcome among Hispanic immigrant women. Journal of Nursing Care Quality, 14(1), 56–62.

Kaestner, R., Pearson, J. A., Keene, D., & Geronimus, A. T. (2009). Stress, Allostatic Load, and Health of Mexican Immigrants*. Social Science Quarterly, 90(5), 1089–1111. https://doi.org/10.1111/j.1540-6237.2009.00648.x

Kaplan, M. S., Huguet, N., Newsom, J. T., & McFarland, B. H. (2004). The association between length of residence and obesity among Hispanic immigrants. American journal of preventive medicine, 27(4), 323-326.

Kim, Y.-H. (2014). Head circumference alone at birth, is it practical? Korean Journal of Pediatrics, 57(2), 72–74. https://doi.org/10.3345/kjp.2014.57.2.72

Klebanov, P. K., Evans, G. W., & Brooks-Gunn, J. (2014). Poverty, ethnicity, and risk of obesity among low birth weight infants. Journal of Applied Developmental Psychology, 35(3), 245–253. https://doi.org/10.1016/j.appdev.2014.01.003

Knops, N. B., Sneeuw, K. C., Brand, R., Hille, E. T., den Ouden, A. L., Wit, J.-M., & Verloove-Vanhorick, S. P. (2005). Catch-up growth up to ten years of age in children born very preterm or with very low birth weight. BMC Pediatrics, 5, 26. https://doi.org/10.1186/1471-2431-5-26

Kramer, M. S. (1987). Determinants of low birth weight: Methodological assessment and meta-analysis. Bulletin of the World Health Organization, 65, 663–737

Kuh, D., Hardy, R., Langenberg, C., Richards, M., & Wadsworth, M. E. J. (2002). Mortality in adults aged 26-54 years related to socioeconomic conditions in childhood and adulthood: post war birth cohort study. BMJ, 325(7372), 1076–1080. https://doi.org/10.1136/bmj.325.7372.1076

Larsen, E. C., Christiansen, O. B., Kolte, A. M., & Macklon, N. (2013). New insights into mechanisms behind miscarriage. BMC medicine, 11(1), 154.

Latal-Hajnal, B., von Siebenthal, K., Kovari, H., Bucher, H. U., & Largo, R. H. (2003). Postnatal growth in VLBW infants: significant association with neurodevelopmental outcome. The Journal of Pediatrics, 143(2), 163–170. https://doi.org/10.1067/S0022-3476(03)00243-9

Law, C. (2001). Adult obesity and growth in childhood. BMJ, 323(7325), 1320–1321. https://doi.org/10.1136/bmj.323.7325.1320

Lawlor, D. A., Ebrahim, S., & Smith, G. D. (2002). Socioeconomic position in childhood and adulthood and insulin resistance: cross sectional survey using data from British women's heart and health study. BMJ, 325(7368), 805. https://doi.org/10.1136/bmj.325.7368.805

Leunissen, R. W. J., Kerkhof, G. F., Stijnen, T., & Hokken-Koelega, A. (2009). Timing and Tempo of First-Year Rapid Growth in Relation to Cardiovascular and Metabolic Risk Profile in Early Adulthood. JAMA, 301(21), 2234–2242. https://doi.org/10.1001/jama.2009.761

Long, J. M., Mareno, N., Shabo, R., & Wilson, A. H. (2012). Overweight and obesity among White, Black, and Mexican American children: Implications for when to intervene. Journal for Specialists in Pediatric Nursing, 17(1), 41–50. https://doi.org/10.1111/j.1744-6155.2011.00309.x

Lopez, M., Latinos and Education: Explaining the Attainment Gap W.D.P.H. Center, Editor 2009.

Luecken, L. J., MacKinnon, D. P., Jewell, S. L., Crnic, K. A., & Gonzales, N. A. (2015). Effects of prenatal factors and temperament on infant cortisol regulation in low-income Mexican American families. Developmental Psychobiology, 57(8), 961–973. https://doi.org/10.1002/dev.21328

Luke, B., & Keith, L. G. (1992). The contribution of singletons, twins and triplets to low birth weight, infant mortality and handicap in the United States. The Journal of reproductive medicine, 37(8), 661-666.

Luke, B., Minogue, J., Witter, F. R., Keith, L. G., & Johnson, T. R. (1993). The ideal twin pregnancy: patterns of weight gain, discordancy, and length of gestation. American Journal of Obstetrics & Gynecology, 169(3), 588-597.

Mann, J. R., Mannan, J., Quiñones, L. A., Palmer, A. A., & Torres, M. (2010). Religion, Spirituality, Social Support, and Perceived Stress in Pregnant and Postpartum Hispanic Women. Journal of Obstetric, Gynecologic, & Neonatal Nursing, 39(6), 645–657. https://doi.org/10.1111/j.1552-6909.2010.01188.x

Masel, M. C., Rudkin, L. L., & Peek, M. K. (2006). Examining the Role of Acculturation in Health Behaviors of Older Mexican Americans. American Journal of Health Behavior, 30(6), 684–699.

McClure, H. H., Snodgrass, J. J., Martinez, C. R., Squires, E. C., Jiménez, R. A., Isiordia, L. E., … Small, J. (2015). Stress, Place, and Allostatic Load Among Mexican Immigrant Farmworkers in Oregon. Journal of Immigrant and Minority Health, 17(5), 1518–1525. https://doi.org/10.1007/s10903-014-0066-z

McCormick, M. C. (2010, January 13). The Contribution of Low Birth Weight to Infant Mortality and Childhood Morbidity [review-article]. Retrieved April 18, 2017, from http://www.nejm.org/doi/full/10.1056/NEJM198501103120204

McCubbin, J. A., Lawson, E. J., Cox, S., Sherman, J. J., Norton, J. A., & Read, J. A. (1996). Prenatal maternal blood pressure response to stress predicts birth weight and gestational age: a preliminary study. American Journal of Obstetrics and Gynecology, 175(3), 706-712.

McEwen, B. S., & Stellar, E. (1993). Stress and the Individual: Mechanisms Leading to Disease. Archives of Internal Medicine, 153(18), 2093–2101. https://doi.org/10.1001/archinte.1993.00410180039004

Mena, F. J., Padilla, A. M., & Maldonado, M. (1987). Acculturative stress and specific coping strategies among immigrant and later generation college students. Hispanic Journal of Behavioral Sciences, 9(2), 207-225.

Min, J., Li, J., Li, Z., & Wang, Y. (2012). Impacts of infancy rapid weight gain on 5-year childhood overweight development vary by age and sex in China. Pediatric obesity, 7(5), 365-373

National Cholesterol Education Program. Third report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Circulation. 2002;106:3143–3421.

Nguyen, K. H., Subramanian, S. V., Sorensen, G., Tsang, K., & Wright, R. J. (2010). Influence of experiences of racial discrimination and ethnic identity on prenatal smoking among urban black and Hispanic women. Journal of Epidemiology & Community Health, jech.2009.107516. https://doi.org/10.1136/jech.2009.107516

Ochiai, H., Shirasawa, T., Ohtsu, T., Nishimura, R., Morimoto, A., Obuchi, R., ... & Kokaze, A. (2012). Number of siblings, birth order, and childhood overweight: a population-based cross-sectional study in Japan. BMC public health, 12(1), 766.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. JAMA, 311(8), 806–814. https://doi.org/10.1001/jama.2014.732

Ong, K. K. L., Ahmed, M. L., Emmett, P. M., Preece, M. A., & Dunger, D. B. (2000). Association between postnatal catch-up growth and obesity in childhood: prospective cohort study. BMJ, 320(7240), 967–971. https://doi.org/10.1136/bmj.320.7240.967

Ong, W. J. (2012). Interfaces of the Word: Studies in the Evolution of Consciousness and Culture. Cornell University Press.

Otiniano Verissimo, A. D., Grella, C. E., Amaro, H., & Gee, G. C. (2014). Discrimination and substance use disorders among Latinos: the role of gender, nativity, and ethnicity. American journal of public health, 104(8), 1421-1428.

Pirinççi, E., Durmuş, B., Gündoğdu, C., & Açik, Y. (2010). Prevalence and risk factors of overweight and obesity among urban school children in Elazig city, Eastern Turkey, 2007. Annals of Human Biology, 37(1), 44–56. https://doi.org/10.3109/03014460903218984

Preciado, A., & D'Anna-Hernandez, K. (n.d.). Acculturative stress is associated with trajectory of anxiety symptoms during pregnancy in Mexican-American women. Journal of Anxiety Disorders. https://doi.org/10.1016/j.janxdis.2016.10.005

Priyadarshini, S., & Aich, P. (2012). Effects of Psychological Stress on Innate Immunity and Metabolism in Humans: A Systematic Analysis. PLOS ONE, 7(9), e43232. https://doi.org/10.1371/journal.pone.0043232

R. M. Reynolds, C. Osmond, D. I. W. Phillips, K. M. Godfrey; Maternal BMI, number of previous deliveries, and Pregnancy Weight Gain: Influences on Offspring Adiposity in Young Adulthood, The Journal of Clinical Endocrinology & Metabolism, Volume 95, Issue 12, 1 December 2010, Pages 5365–5369, https://doi.org/10.1210/jc.2010-0697

Ramos-Sánchez, L., & Atkinson, D. (2009). The Relationships Between Mexican American Acculturation, Cultural Values, Gender, and Help-Seeking Intentions. Journal of Counseling & Development, 87(1), 62-71.

Redfield, R., Linton, R., & Herskovits, M. J. (1936). Memorandum for the Study of Acculturation. American Anthropologist, 38(1), 149–152. https://doi.org/10.1525/aa.1936.38.1.02a00330

Robinson, J. S., Moore, V. M., Owens, J. A., & McMillen, I. C. (2000). Origins of fetal growth restriction. European Journal of Obstetrics, Gynecology, and Reproductive Biology, 92, 13–19. 8.

Roche, K. M., Ghazarian, S. R., & Fernandez-Esquer, M. E. (2012). Unpacking Acculturation: Cultural Orientations and Educational Attainment Among Mexican-Origin Youth. Journal of Youth and Adolescence, 41(7), 920–931. https://doi.org/10.1007/s10964-011-9725-8.

Rondó, P. H., Ferreira, R. F., Nogueira, F., Ribeiro, M. C. N., Lobert, H., & Artes, R. (2003). Maternal psychological stress and distress as predictors of low birth weight, prematurity and intrauterine growth retardation. European journal of clinical nutrition, 57(2), 266.

Salvador-Moysén, J., Martínez-López, Y., Ramírez-Aranda, J. M., Aguilar-Durán, M., & Reyes-Romero, M. A. (2014). The social conditions in the genesis of preeclampsia. Open Journal of Epidemiology, 4(03), 115.

Sandler, V., Reisetter, A. C., Bain, J. R., Muehlbauer, M. J., Nodzenski, M., Stevens, R. D., ... & Scholtens, D. M. (2017). Associations of maternal BMI and insulin resistance with the maternal metabolome and newborn outcomes. Diabetologia, 60(3), 518-530.

Sandman, C. A., Wadhwa, P. D., Dunkel-Schetter, C., CHICZ-DeMET, A., Belman, J., Porto, M., … Crinella, F. M. (1994). Psychobiological Influences of Stress and HPA Regulation on the Human Fetus and Infant Birth Outcomes. Annals of the New York Academy of Sciences, 739(1), 198–210. https://doi.org/10.1111/j.1749-6632.1994.tb19822.x

Sapolsky, R. M. (2005). The Influence of Social Hierarchy on Primate Health. Science, 308(5722), 648–652. https://doi.org/10.1126/science.1106477

Scribner, R., & Dwyer, J. H. (1989). Acculturation and low birthweight among Latinos in the Hispanic HANES. American Journal of Public Health, 79(9), 1263–1267. https://doi.org/10.2105/AJPH.79.9.1263

Scribner, R., & Dwyer, J. H. (1989). Acculturation and low birthweight among Latinos in the Hispanic HANES. American journal of public health, 79(9), 1263-1267.

Sebire, N. J., Jolly, M., Harris, J. P., Wadsworth, J., Joffe, M., Beard, R. W., ... & Robinson, S. (2001). Maternal obesity and pregnancy outcome: a study of 287 213 pregnancies in London. International journal of obesity, 25(8), 1175.

Slykerman, R. F., Thompson, J., Waldie, K., Murphy, R., Wall, C., & Mitchell, E. A. (2015). Maternal stress during pregnancy is associated with moderate to severe depression in 11-year-old children. Acta Paediatrica, 104(1), 68–74. https://doi.org/10.1111/apa.12787

Smith, G. C. S. (2004). First trimester origins of fetal growth impairment. Seminars in Perinatology, 28(1), 41–50. https://doi.org/10.1053/j.semperi.2003.10.012

Spong, C. Y. (2013). Defining "Term" Pregnancy: Recommendations From the Defining "Term" Pregnancy Workgroup. JAMA, 309(23), 2445–2446. https://doi.org/10.1001/jama.2013.6235

Stettler, N., Kumanyika, S. K., Katz, S. H., Zemel, B. S., & Stallings, V. A. (2003). Rapid weight gain during infancy and obesity in young adulthood in a cohort of African Americans. The American Journal of Clinical Nutrition, 77(6), 1374–1378.

Stettler, N., Zemel, B. S., Kumanyika, S., & Stallings, V. A. (2002). Infant Weight Gain and Childhood Overweight Status in a Multicenter, Cohort Study. Pediatrics, 109(2), 194–199. https://doi.org/10.1542/peds.109.2.194

Stout, S. A., Espel, E. V., Sandman, C. A., Glynn, L. M., & Davis, E. P. (2015). Fetal programming of children's obesity risk. Psychoneuroendocrinology, 53, 29–39. https://doi.org/10.1016/j.psyneuen.2014.12.009

Sullivan, M. C., McGrath, M. M., Hawes, K., & Lester, B. M. (2008). Growth Trajectories of Preterm Infants: Birth to 12 Years. Journal of Pediatric Health Care, 22(2), 83–93. https://doi.org/10.1016/j.pedhc.2007.02.008

Talge, N. M., Neal, C., Glover, V., & the Early Stress, T. R. and P. S. N. F. and N. E. on C. and A. M. H. (2007). Antenatal maternal stress and long-term effects on child neurodevelopment: how and why? Journal of Child Psychology and Psychiatry, 48(3–4), 245–261. https://doi.org/10.1111/j.1469-7610.2006.01714.x

Tanner, J. M. (1994). Growth from birth to two: a critical review. Acta Medica Auxologica, 26, 7-45.

Taveras, E. M., Rifas-Shiman, S. L., Belfort, M. B., Kleinman, K. P., Oken, E., & Gillman, M. W. (2009). Weight status in the first 6 months of life and obesity at 3 years of age. Pediatrics, 123(4), 1177-1183.

Thayer, Z. M., & Kuzawa, C. W. (2015). Ethnic discrimination predicts poor self-rated health and cortisol in pregnancy: Insights from New Zealand. Social Science & Medicine, 128, 36-42.

Thorén, A., Werner, B., Lundholm, C., Bråbäck, L., & Silfverdal, S. A. (2015). A rapid growth rate in early childhood is a risk factor for becoming overweight in late adolescence. Acta Paediatrica, 104(11), 1138-1143.

Torres, L., Driscoll, M. W., & Voell, M. (2012). Discrimination, acculturation, acculturative stress, and Latino psychological distress: A moderated mediational model. Cultural Diversity and Ethnic Minority Psychology, 18(1), 17–25. https://doi.org/10.1037/a0026710

Tynes, B. M., Umana-Taylor, A. J., Rose, C. A., Lin, J., & Anderson, C. J. (2012). Online racial discrimination and the protective function of ethnic identity and self-esteem for African American adolescents. Developmental psychology, 48(2), 343.

US Census Bureau. (2007). Statistical abstract of the United States. US Government Printing Office.

Vella, C. A., Ontiveros, D., Zubia, R. Y., & Bader, J. O. (2011). Acculturation and metabolic syndrome risk factors in young Mexican and Mexican–American women. Journal of immigrant and minority health, 13(1), 119-126.

Wadhwa, P. D., Sandman, C. A., Porto, M., Dunkel-Schetter, C., & Garite, T. J. (1993). The association between prenatal stress and infant birth weight and gestational age at birth: a prospective investigation. American Journal of Obstetrics & Gynecology, 169(4), 858-865.

Westerberg, A. C., Henriksen, C., Ellingvåg, A., Veierød, M. B., Júlíusson, P. B., Nakstad, B., … Drevon, C. A. (2010). First year growth among very low birth weight infants. Acta Pædiatrica, 99(4), 556–562. https://doi.org/10.1111/j.1651-2227.2009.01667.x

Whitehouse, A. J. O., Hickey, M., Stanley, F. J., Newnham, J. P., & Pennell, C. E. (2011). Brief Report: A Preliminary Study of Fetal Head Circumference Growth in Autism Spectrum Disorder. Journal of Autism and Developmental Disorders, 41(1), 122–129. https://doi.org/10.1007/s10803-010-1019-6

WHO Anthro for personal computers, version 3.2.2, 2011: Software for assessing growth and development of the world's children. Geneva: WHO, 2010 (http://www.who.int/childgrowth/software/en/).

Williams, D. R., & Mohammed, S. A. (2009). Discrimination and racial disparities in health: evidence and needed research. Journal of Behavioral Medicine, 32(1), 20–47. https://doi.org/10.1007/s10865-008-9185-0

Williams, L. R., & Rueda, H. A. (2016). Mexican American adolescent couples' vulnerability for observed negativity and physical violence: Pregnancy and acculturation mismatch. Journal of Adolescence, 52, 170–181. https://doi.org/10.1016/j.adolescence.2016.08.001

Williams, S. M., & Goulding, A. (2009). Early Adiposity Rebound Is an Important Predictor of Later Obesity. Obesity, 17(7), 1310–1310. https://doi.org/10.1038/oby.2009.104

Wu, G., Bazer, F. W., Cudd, T. A., Meininger, C. J., & Spencer, T. E. (2004). Maternal nutrition and fetal development. The Journal of nutrition, 134(9), 2169-2172.

Yoshida, Y., Scribner, R., Chen, L., Broyles, S., Phillippi, S., & Tseng, T. S. (2017). Peer Reviewed: Role of Age and Acculturation in Diet Quality Among Mexican Americans—Findings From the National Health and Nutrition Examination Survey, 1999–2012. Preventing chronic disease, 14.

Yu, Z., Han, S., Zhu, J., Sun, X., Ji, C., & Guo, X. (2013). Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. PloS one, 8(4), e61627.

Zamboni, B. D., & Crawford, I. (2007). Minority Stress and Sexual Problems among African-American Gay and Bisexual Men. Archives of Sexual Behavior, 36(4), 569–578. https://doi.org/10.1007/s10508-006-9081-z

Zeiders, Updegraff, Umaña-Taylor, Wheeler, Perez-Brena, & Rodríguez. (2013). Mexican-Origin Youths' Trajectories of Depressive Symptoms: The Role of Familism Values. Journal of Adolescent Health, 53(5), 648-654.

Zhang, X., & Kramer, M. S. (2009). Variations in Mortality and Morbidity by Gestational Age among Infants Born at Term. The Journal of Pediatrics, 154(3), 358–362.e1. https://doi.org/10.1016/j.jpeds.2008.09.013

Zhou, J., Dang, S., Zeng, L., Gao, W., Wang, D., Li, Q., ... & Yan, H. (2016). Rapid infancy weight gain and 7-to 9-year childhood obesity risk: A prospective cohort study in rural western China. Medicine, 95(16).

Zhu, P., Tao, F., Hao, J., Sun, Y., & Jiang, X. (2010). Prenatal life events stress: implications for preterm birth and infant birthweight. American Journal of Obstetrics and Gynecology, 203(1), 34.e1-34.e8. https://doi.org/10.1016/j.ajog.2010.02.023

Table 1.
Maternal Demographics

Characteristic	N	Percentage
Mom age		
18-19	4	4.35%
20-29	53	57.61%
30-39	34	36.96%
Parity		
Primiparous	21	22.83%
1	23	25.00%
2	32	34.78%
3	10	10.87%
4 or more	6	6.52%
BMI		
≤19.99	6	6.52%
20 – 29.99	60	65.22%
30 – 39.99	24	26.09%
40≤	2	2.17%
Place of Birth		
US	19	20.65%
Outside of US	73	79.35%
Years in the US		
≤9	18	19.57%
10-19	47	51.09%
20 - 28	27	29.35%
Primary Language		
Spanish	76	82.61%
English	5	5.43%
Both English and Spanish	11	11.96%
Marital Status		
Living with biological father	40	43.48%
Married to biological father	38	41.30%
Never married	13	14.13%
Separated	1	1.09%
Annual Household Income		
≤20,000	33	37.93%
20,000 -29,999	32	36.78%
30,000 – 39,999	11	12.64%
Highest Educational attainment		
≤ 8years	17	18.48%
9 – 11 years	26	28.26%
12 years	34	36.96%
13≤	15	16.30%

Table 2.
Pearson's Correlation Coefficients between Potential Covariate Maternal Demographics and Outcome Variables.

Primary Outcome variables	Maternal BMI	Term deliveries	Years in the US	Age	Income	Education
GA at birth	**.284****	.116	.078	.020	.114	−.085
Birth Weight percentile	**.366****	.173	.098	.082	.132	−.142
BMI percentile at newborn wellness check	**.432****	.188	.007	.080	.097	−.162
OFC percentile at newborn wellness check	**.238***	.059	.052	−.028	.065	−.050
Weight change	−.100	−.136	−.096	−.037	−.107	.054
BMI change	−.192	**−.224***	−.032	−.073	−.157	.087
OFC change	−.191	−.189	−.019	−.127	−.092	.025

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Note. (*n*=92). Abbreviations: OFC, occipital-frontal head circumference.

Table 3.

Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring gestational age at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	.068	.024	2.813	.006	7.914	.006	.081
Step 2	Mom BMI	.068	.024	2.799	.006	.156	.694	.002
	PSS	−.008	.020	−.395	.694			
Step 3	Mom BMI	.068	.025	2.731	.008	.056	.946	.001
	PSS	−.009	−.021	−.437	.663			
	MO	−.087	.271	−.319	.751			
	AO	−.020	.138	−.142	.888			
Step 4	Mom BMI	**.068**	.025	2.706	.008	.029	.865	.000
	PSS	−.008	.022	−.350	.727			
	MO	−.079	.276	−.286	.775			
	AO	−.021	.139	−.150	.881			
	SAFE	−.001	.008	−.171	.865			

Note. (*n*=92) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress.

Table 4.
Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring gestational age at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	.069	.024	2.839	.006	8.060	.006	.083
Step 2	Mom BMI	.069	.024	2.824	.006	.127	.722	.001
	PSS	−.007	.020	−.356	.722			
Step 3	Mom BMI	.068	.025	2.746	.007	.079	.924	.002
	PSS	−.009	.021	−.428	.669			
	MO	−.108	.272	−.398	.692			
	AO	−.007	.138	−.052	.959			
Step 4	Mom BMI	**.072**	.025	2.849	.006	.762	.385	.008
	PSS	−.004	.022	−.167	.867			
	MO	−.086	.274	−.315	.753			
	AO	−.006	.138	−.042	.966			
	DSS	−.317	.363	−.873	.385			

Note. (*n*=91) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress.

Table 5.

Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring weight percentile at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(91)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	1.025	.418	2.451	.016	33.948	.000	.433
	GA at Birth	11.923	1.742	6.846	.000			
Step 2	Mom BMI	1.025	.421	2.436	.017	.023	.879	.000
	GA at Birth	11.935	1.753	6.808	.000			
	PSS	.050	.329	.152	.879			
Step 3	Mom BMI	1.058	.424	2.493	.015	.528	.592	.007
	GA at Birth	11.964	1.764	7.784	.000			
	PSS	.132	.341	.386	.700			
	MO	3.186	4.465	.714	.477			
	AO	−1.427	2.264	−.630	.530			
Step 4	Mom BMI	**1.041**	.433	2.402	.018	.058	.810	.000
	GA at Birth	**11.972**	1.774	6.750	.000			
	PSS	.102	.365	.279	.781			
	MO	3.014	4.546	.663	.509			
	AO	1.398	2.280	−.613	.541			
	SAFE	.032	.132	.241	.810			

Note. (*n*=92) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress.

Table 6.

Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring weight percentile at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	1.036	.421	2.462	.016	33.165	.000	.430
	GA at Birth	11.835	1.760	6.725	.000			
Step 2	Mom BMI	1.036	.423	2.447	.016	.028	.868	.000
	GA at Birth	11.846	1.771	6.689	.000			
	PSS	.055	.331	.167	.0868			
Step 3	Mom BMI	1.065	.427	2.493	.015	.471	.626	.006
	GA at Birth	11.989	1.783	6.671	.000			
	PSS	.132	3.343	.385	.701			
	MO	3.062	4.504	.680	.498			
	AO	−1.361	2.285	−.596	.553			
Step 4	Mom BMI	**1.057**	.437	2.418	.018	.010	.992	.000
	GA at Birth	**11.914**	1.802	6.612	.000			
	PSS	.123	.359	.341	.734			
	MO	3.023	4.548	.665	.508			
	AO	−1.364	2.298	−.593	.555			
	DSS	.592	6.053	.098	.922			

Note. (*n*=91) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress.

Table 7.

Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring BMI percentile at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(91)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	1.767	.494	3.575	.001	19.540	.000	.305
	GA at Birth	8.027	2.058	3.900	.000			
Step 2	Mom BMI	1.763	.495	3.564	.001	.906	.344	.007
	GA at Birth	8.109	2.061	3.935	.000			
	PSS	.368	.387	.952	.344			
Step 3	Mom BMI	1.814	.495	3.663	.000	1.199	.307	.019
	GA at Birth	8.134	2.058	3.953	.000			
	PSS	.496	.398	1.244	.217			
	MO	4.023	5.210	.772	.442			
	AO	−3.221	2.642	−1.219	.226			
Step 4	Mom BMI	**1.878**	.503	3.731	.000	.587	.446	.005
	GA at Birth	**8.105**	2.063	3.929	.000			
	PSS	.607	.425	1.428	.157			
	MO	4.659	5.288	.881	.381			
	AO	13.329	2.652	−1.255	.213			
	SAFE	−.117	.153	−.766	.446			

Note. (*n*=92) **Bold** indicates significant predictor variables $p = <.05$.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress.

Table 8.

Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring BMI percentile at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	1.732	.493	3.512	.001	20.043	.000	.313
	GA at Birth	8.317	2.062	4.033	.000			
Step 2	Mom BMI	1.729	.494	3.502	.001	.833	.364	.007
	GA at Birth	8.388	2.066	4.060	.000			
	PSS	.352	.386	.912	.364			
Step 3	Mom BMI	1.781	.492	3.617	.001	1.503	.228	.023
	GA at Birth	8.468	2.056	4.119	.000			
	PSS	.494	.396	1.248	.215			
	MO	4.655	5.192	.897	.373			
	AO	−3.557	2.634	−1.351	.180			
Step 4	Mom BMI	**1.783**	.504	3.538	.001	.000	.986	.000
	GA at Birth	**8.465**	2.077	4.075	.000			
	PSS	.496	.414	1.197	.235			
	MO	4.663	5.243	.889	.376			
	AO	−3.556	2.649	−1.342	.183			
	DSS	−.125	6.979	−.018	.986			

Note. (*n*=91) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress.

Table 9. *Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring head circumference percentile at birth.*

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	.343	.504	.682	.497	26.036	.000	.372
	GA at Birth	14.048	2.108	6.665	.000			
Step 2	Mom BMI	.350	.504	.695	.489	.965	.329	.007
	GA at Birth	13.947	2.110	6.609	.000			
	PSS	−.386	.393	−.982	.329			
Step 3	Mom BMI	.379	.507	.747	.457	.640	.530	.009
	GA at Birth	14.023	2.121	6.611	.000			
	PSS	−.286	.407	−.703	.484			
	MO	2.992	5.320	.562	.575			
	AO	−.2.449	2.724	−.899	.371			
Step 4	Mom BMI	.525	.510	1.030	.306	2.751	.101	.019
	GA at Birth	**13.917**	2.101	6.625	.000			
	PSS	−.048	.428	−.112	.911			
	MO	4.346	5.329	.816	.417			
	AO	−2.632	2.699	−.975	.332			
	SAFE	−.257	.155	−1.659	.101			

Note. (*n*=91) **Bold** indicates significant predictor variables *p* = <.05.Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress.

Table 10.

Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring head circumference percentile at birth.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(89)	*p*	ΔF	P	ΔR^2
Step 1	Mom BMI	.360	.506	.711	.479	25.230	.000	.367
	GA at Birth	13.909	2.129	6.534	.000			
Step 2	Mom BMI	.366	.507	.723	.472	.922	.340	.007
	GA at Birth	13.818	2.132	6.482	.000			
	PSS	−.379	.394	−.960	.340			
Step 3	Mom BMI	.389	.510	.763	.448	.565	.571	.008
	GA at Birth	13.923	2.146	6.488	.000			
	PSS	−286	.409	−.699	.486			
	MO	2.808	5.366	.523	.602			
	AO	−2.346	2.750	−.853	.396			
Step 4	Mom BMI	.529	.516	1.024	.309	2.090	.152	.015
	GA at Birth	**13.614**	2.143	6.353	.000			
	PSS	−.120	.423	−.284	.777			
	MO	3.473	5.351	.649	.513			
	AO	−2.281	2.732	−.835	.406			
	DSS	−10.291	7.119	−1.446	.152			

Note. (*n*=90) **Bold** indicates significant predictor variables *p* = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress.

Table 11.

Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring change in weight at 4 months.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(90)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	.060	.488	.123	.903	2.791	.067	.060
	Infant age	−.081	.034	−2.357	.021			
Step 2	GA at Birth	.057	.491	.117	.907	.017	.896	.000
	Infant age	−.081	.035	−2.329	.022			
	PSS	−.013	.096	−.131	.896			
Step 3	GA at Birth	.088	.494	.178	.859	.622	.539	.014
	Infant	−.083	.035	−2.339	.022			
	PSS	.014	.100	.143	.887			
	MO	1.436	1.311	1.095	.277			
	AO	−.032	.669	−.047	.962			
Step 4	GA at Birth	.086	.497	.172	.864	.026	.871	.001
	Infant age	**−.082**	.036	−2.295	.024			
	PSS	.008	.107	.078	.938			
	MO	1.408	1.330	1.059	.293			
	AO	−.029	.673	−.043	.966			
	SAFE	.006	.039	.163	.871			

Note. (*n*=91) **Bold** indicates significant predictor variables $p = <.05$. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress.

Table 12.

Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring change in weight at 4 months.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(89)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	−.083	.466	−.178	.859	2.264	.110	.049
	Infant age	−.070	.033	−2.121	.037			
Step 2	GA at Birth	−.084	.469	−.179	.858	.003	.957	.000
	Infant age	−.070	.033	−2.101	.039			
	PSS	−.005	.092	−.054	.957			
Step 3	GA at Birth	−.058	.474	−.122	.903	.361	.698	.008
	Infant	−.073	.034	−2.137	.036			
	PSS	−.013	.095	.134	.893			
	MO	1.067	1.257	.849	.398			
	AO	.108	.640	.168	.867			
Step 4	GA at Birth	−.048	.476	−.100	.921	.240	.626	.003
	Infant age	**−.071**	.034	−2.071	.042			
	PSS	−.001	.100	−.005	.996			
	MO	1.028	1.266	.812	.419			
	AO	.098	.644	.152	.880			
	DSS	.822	1.677	−.490	.626			

Note. (*n*=90) **Bold** indicates significant predictor variables *p* = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress.

Table 13.
Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring change in BMI at 4 month.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(89)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	−.002	.001	−1.512	.134	4.176	.004	.164
	First visit age	−.001	.001	−2.242	.028			
	Age Difference	.000	.000	−2.396	.019			
	Term Delivery	−.003	.001	−2.572	.012			
Step 2	GA at Birth	−.002	.001	−1.503	.137	.451	.504	.004
	First visit age	−.001	.001	−2.091	.040			
	Age Difference	.000	.000	−2.366	.020			
	Term Delivery	−.003	.001	−2.494	.015			
	PSS	.000	.000	−.671	.504			
Step 3	GA at Birth	−.002	.001	−1.407	.163	.331	.719	.007
	First visit age	−.001	.001	−2.085	.040			
	Age Difference	.000	.000	−2.409	.018			
	Term Delivery	−.003	.001	−2.459	.016			
	PSS	.000	.000	−.477	.635			
	MO	.002	.003	.787	.433			
	AO	.000	.002	.286	.776			
Step 4	GA at Birth	−.002	.001	−1.407	.163	1.377	.244	.014
	First visit age	−.001	.001	−2.037	.045			
	Age Difference	.000	.000	−2.126	.037			
	Term Delivery	−.004	.001	−2.671	.009			
	PSS	.000	.000	−.828	.410			
	MO	.002	.003	.661	.510			
	AO	.000	.002	.184	.854			
	SAFE	.000	.000	1.173	.244			

Note. (*n*=90) **Bold** indicates significant predictor variables p = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress. Age difference is the difference between infant age in days at the first time point at which BMI measure was collected and infant age at the second time point at which BMI measure was collected (Time 2 age **–** Time 1 age**)** in order to calculate change rate.

Table 14.
Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring change in BMI at 4 month.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(88)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	−.002	.001	−1.847	.068	4.447	.003	.175
	First visit age	−.001	.001	−2.417	.018			
	Age Difference	.000	.000	−2.099	.039			
	Term Delivery	−.003	.001	−2.712	.008			
Step 2	GA at Birth	−.002	.001	−1.834	.070	.351	.555	.003
	First visit age	−.001	.001	−2.273	.026			
	Age Difference	.000	.000	−2.075	.041			
	Term Delivery	−.003	.001	−2.637	.010			
	PSS	.000	.000	−.593	.555			
Step 3	GA at Birth	−.002	.001	−1.752	.084	.228	.797	.005
	First visit age	−.001	.001	−2.272	.026			
	Age Difference	.000	.000	−2.145	.035			
	Term Delivery	−.003	.001	−2.495	.015			
	PSS	−.000	.000	−.481	.631			
	MO	.002	.003	.550	.584			
	AO	.001	.002	.443	.659			
Step 3	GA at Birth	−.002	.001	−1.407	.163	.763	.385	.008
	First visit age	**−.001**	.001	−2.037	.045			
	Age Difference	**.000**	.000	−2.126	.037			
	Term Delivery	**−.003**	.001	−2.671	.009			
	PSS	.000	.000	−.700	.486			
	MO	.002	.003	.503	.616			
	AO	.001	.002	.339	.735			
	DSS	.004	.004	.874	.385			

Note. (*n*=89) **Bold** indicates significant predictor variables *p* = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress. Age difference is the difference between infant age in days at the first time point at which head circumference measure was collected and infant age at the second time point at which head circumference measure was collected (Time 2 age **–** Time 1 age**)** in order to calculate change rate.

Table 15.

Multiple linear regression analysis of maternal acculturative stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring head circumference change at 4 months.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(85)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	−.003	.001	−3.574	.001	7.130	.000	.207
	First visit age	−.001	.000	−2.418	.018			
	Age Difference	.000	.000	−2.109	.038			
Step 2	GA at Birth	−.003	.001	−3.552	.001	.000	.997	.000
	First visit age	−.001	.000	−2.399	.019			
	Age Difference	.000	.000	−2.092	.040			
	PSS	−4.756E−7	.000	−.003	.997			
Step 3	GA at Birth	−.003	.001	−3.514	.001	.417	.661	.008
	First visit age	−.001	.000	−2.464	.016			
	Age Difference	.000	.000	−2.207	.030			
	PSS	−2.580E−5	.000	−.169	.866			
	MO	.000	.002	−.205	.838			
	AO	.001	.001	.837	.405			
Step 4	GA at Birth	**−.003**	.001	−3.506	.001	.107	.744	.001
	First visit age	**−.001**	.000	−2.464	.016			
	Age Difference	**.000**	.000	−2.064	.042			
	PSS	−4.376E−5	.000	−.269	.789			
	MO	−.001	.002	−.255	.800			
	AO	.001	.001	.823	.413			
	SAFE	1.908E−5	.000	.327	.744			

Note. (*n*=86) **Bold** indicates significant predictor variables *p* = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; SAFE, Acculturative Stress. Age difference is the difference between infant age in days at the first time point at which head circumference measure was collected and infant age at the second time point at which head circumference measure was collected (Time 2 age – Time 1 age**)** in order to calculate change rate.

Table 16. Multiple linear regression analysis of maternal perceived discrimination stress, Mexican orientation and Anglo Orientation, in early pregnancy as predictors of offspring head circumference change at 4 months.

		Parameter Estimates				Model Summary		
Block	Predictor	*b*	SE(*b*)	*t*(84)	*p*	ΔF	P	ΔR^2
Step 1	GA at Birth	−.003	.001	−3.714	.000	7.300	.000	.213
	First visit age	−.001	.000	−2.464	.016			
	Age Difference	.000	.000	−1.916	.059			
Step 2	GA at Birth	−.003	.001	−3.692	.000	.001	.972	.000
	First visit age	−.001	.000	−2.446	.017			
	Age Difference	.000	.000	−1.903	.061			
	PSS	5.234E−6	.000	.036	.972			
Step 3	GA at Birth	−.003	.001	−3.674	.000	.557	.575	.011
	First visit age	−.001	.000	−2.528	.013			
	Age Difference	.000	.000	−2.033	.045			
	PSS	−2.573E−5	.000	−.170	.866			
	MO	−.001	.002	−.333	.740			
	AO	.001	.001	.927	.357			
Step 4	GA at Birth	**−.003**	.001	−3.664	.000	.102	.751	.001
	First visit age	**−.001**	.000	−2.521	.014			
	Age Difference	**.000**	.000	−2.045	.044			
	PSS	−1.137E−5	.000	−.072	.943			
	MO	−.001	.002	−.295	.769			
	AO	.001	.001	.943	.349			
	DSS	−.001	.003	−.319	.751			

Note. (*n*=85) **Bold** indicates significant predictor variables *p* = <.05. Abbreviations: GA, Gestational age; MO, Mexican Orientation; AO, Anglo Orientation, PSS, General Perceived Stress; DSS, Perceived Discrimination Stress. Age difference is the difference between infant age in days at the first time point at which head circumference measure was collected and infant age at the second time point at which head circumference measure was collected (Time 2 age – Time 1 age**)** in order to calculate change rate.