



Maternal blood pressure and birth weight associations in U.S.-born and foreign-born Latinas

Anna M. Strahm*,
North Dakota State University

Clayton J. Hilmert*,
North Dakota State University

Belinda Campos*,
University of California, Irvine

Robert Dvorak,
University of Central Florida

Marc Schenker
University of California, Davis

Abstract

Objectives: Research suggests that acculturating to the U.S. is detrimental for immigrants' health. Consistent with this pattern, higher levels of U.S. acculturation among Latina-American women have been associated with giving birth to lower birth weight babies. The mechanisms that shape this shift in pregnancy health are not clear, but researchers have begun to consider the role of physiological systems that are sensitive to social experience. The present study examined the association of cultural orientation with blood pressure (BP) trajectories over the course of pregnancy.

Method: In a study of 1,011 U.S. and foreign-born Latina-American women, cultural orientation was assessed and multiple BP measures were collected throughout pregnancy. Post-pregnancy data, including gestational age-adjusted birth weight, were extracted from medical records. Bayesian structural equation models examined average BP and slopes of BP change during pregnancy while accounting for psychosocial stress, support, and pregnancy health-related factors (e.g., maternal age, smoking).

Results: We found evidence that greater U.S. orientation was associated with higher diastolic blood pressure (DBP) and steeper increases in DBP, which was associated with less fetal growth.

Conclusions: This is the first evidence that BP may mediate the association between cultural orientation and pregnancy outcomes in Latina-American women. These findings advance our understanding of the biopsychosocial pathways through which acculturation to the U.S. links with health. As scholars seek to better understand the influence of U.S. acculturation on health,

Correspondence concerning this article should be addressed to Clayton J. Hilmert, NDSU Dept. 2765, PO Box 6050, Fargo, ND 58108-6050. clayton.hilmert@ndsu.edu.

*Equal contributions

focusing on the cardiovascular system and other physiological systems that are sensitive to social experience is warranted and likely to prove valuable.

In the United States, racial and ethnic minorities experience elevated risk for poorer health than more affluent European Americans (Schwartz & Unger, 2017). In the case of Latinas of recent immigrant heritage, initial favorable pregnancy outcomes worsen and social ties that are protective for health appear to weaken with more time in the U.S. (Callister & Birkhead, 2002; Zambrana, Scrimshaw, Collins, & Dunkel-Schetter, 1997). These changes toward worsening health are frequently attributed to acculturation, a process broadly defined as the adaptation to a culture that is new or unfamiliar. The complexities of acculturation are becoming better understood (Nino & Hearne, 2022; Schwartz & Unger, 2017; Schwartz, Unger, Zamboanga, & Szapocznik, 2010), but mechanisms through which acculturation is linked with health, including pregnancy outcomes, are not well studied. Researchers have begun to consider the role of physiological systems that are sensitive to social experience in the link between U.S. acculturation and poorer health (D'Anna-Hernandez et al., 2012; Schwartz & Unger, 2017) including blood pressure (BP) (Steffen, Smith, Larson, & Butler, 2006). The goal of this paper was to examine the role of BP, an indicator of the functioning of the cardiovascular system, in the established links between U.S. acculturation and pregnancy outcomes in U.S.-born (USB) and foreign-born (FB) U.S. Latinas.

Latinas, U.S. Acculturation, and Pregnancy Outcomes

Latinas in the U.S., especially immigrant women, have infants whose birth weight is as healthy as that of more affluent European American women (Callister & Birkhead, 2002; Campos et al., 2008; Montoya-Williams et al., 2020; Zambrana et al., 1997). This surprising pattern is an important example of the “Latino Health Paradox” whereby Latinos in the U.S. have historically had better than expected health despite their socioeconomic disadvantages and devalued ethnic minority status (Abraido-Lanza, Dohrenwend, Ng-Mak, & Turner, 1999; Markides & Coreil, 1986; Ruiz, Steffen, & Smith, 2013). Unfortunately, these initially favorable perinatal outcomes worsen with more time and acculturation in the U.S. (Callister & Birkhead, 2002; Campos, Schetter, Walsh, & Schenker, 2007; Zambrana et al., 1997).

Acculturative changes, including those characterized by a transition from Latino to U.S. orientation, likely involve biopsychosocial mechanisms relevant to pregnancy outcomes, such as stress. In large-scale prospective studies stress has been predictive of adverse pregnancy outcomes, including lower fetal growth (Dunkel Schetter, 2009, 2011). With more time in the U.S. and higher levels of U.S. acculturation, Latinas report higher levels of stress (Kasirye et al., 2005; Zambrana et al., 1997) and experience greater physiological dysfunction (Cedillo et al., 2021). This suggests that U.S. acculturation may be linked to Latinas’ susceptibility to the adverse effects of stress and dysfunction in stress-related physiological systems, such as the cardiovascular system (Marwaha, 2022).

Blood pressure and fetal growth

One potential mediator of the link between acculturation and fetal growth is cardiovascular functioning. The hemodynamics involved in the circulation of maternal oxygen and nutrients

to the uterus is critical for fetal growth. Changes in BP throughout pregnancy reflect this important dynamic. During pregnancy BP gradually decreases in the first 22 to 24 weeks gestation and then gradually increases until parturition (Grindheim, Estensen, Langesaeter, Rosseland, & Toska, 2012; Pivarnik, Szymanski, & Conway, 2016). These adjustments are, in part, the result of an increase in blood volume necessary to sustain the growing fetus. Although a mid to late term increase in BP is normative, high BP can also indicate risk of complications.

During pregnancy, BP that is clinically high at its peak (systolic BP 140mmHg) or at its nadir (diastolic BP 90mmHg) increases risk of pre-eclampsia, a risk factor for lower fetal growth (Preeclampsia and Eclampsia, 2013). At sub-clinical levels and in the context of high stress, our research suggests that diastolic BP (DBP) is a stronger predictor of fetal growth than systolic (SBP) (Hilmert et al., 2014; Hilmert et al., 2008). Therefore, in the present study we consider SBP and DBP, separately.

Associations between BP during pregnancy and pregnancy-related outcomes are well documented. However, the pathways by which acculturation influences BP-related processes during pregnancy are not. In the current study we examine the complex dynamics of cultural orientation, stress, BP during pregnancy, and fetal growth in a sample of 1,011 Latinas.

Methods

Participants

Participants for this study were drawn from 1,024 pregnant Latinas ($n = 761$ FB Latinas, $n = 263$ USB Latinas) who took part in the Study for Hispanic Acculturation, Reproduction, and the Environment (SHARE). Information on SHARE is reported in Kasirye et al. (2005). SHARE was funded by the National Institute for Environmental Health Sciences (NIEHS) to investigate factors affecting reproductive outcomes among Latinas in a low-income California urban agricultural community. SHARE participants were recruited during their first prenatal visit at one of six obstetrics and gynecology clinics affiliated with San Joaquin General Hospital, in Stockton, California. Participants were eligible for the present study if they had data recorded from at least one prenatal appointment and a record of gestational age and birth weight following delivery. Based on those criteria, 1,011 Latinas were eligible for this study [$n = 753$, FB (97.5% Mexican); $n = 258$, USB].

Procedures

During their initial prenatal visit, women who consented were scheduled for a 45-minute personal interview with a trained bilingual/bicultural field worker. Interviews were conducted in either English (26%) or Spanish (73%) in accord with participant preference (Campos et al., 2007). Over the course of the interview, participants answered questions about their U.S. acculturation, perceived stress, pregnancy anxiety, and family support. Participants were compensated with a \$10 gift card to Walmart.

Measures

Demographics.—Interviewers used standard questions to obtain participant's birthplace, birth year, marital status, and household income. Self-reported information was verified via medical record.

U.S. Orientation.—The Revised Acculturation Rating Scale for Mexican Americans-Short Version (ARSMA-II-SV) (Cuellar, Arnold, & Maldonado, 1995) is made up of two 6-item subscales of Mexican and Anglo orientation focusing primarily on language preferences, making the scale appropriate for Spanish speakers in general. Each subscale had high reliability (Mexican $\alpha=.88$; Anglo $\alpha=.94$). To examine the extent to which U.S. culture had become predominant a *U.S. orientation score* was computed by subtracting each participant's mean Mexican orientation score from their Anglo orientation score¹ (Cuellar et al., 1995).

Blood Pressure.—Diastolic and SBP readings were taken during regularly scheduled prenatal appointments. These readings and the gestational timing of the readings were retrieved from participants' medical records. Each participant had up to three BP readings ($M=2.98$ readings) from separate visits at different points in gestation.

Pregnancy Outcomes.—Outcome variables were obtained from medical records. Infant weight was measured after delivery during documentation of live birth. Gestation length was computed from last menstrual period and ultrasound.

Psychosocial Factors

To focus on U.S. orientation, the following variables were included to account for known associations with BP (Hilmert et al., 2008) and pregnancy outcomes (Dunkel Schetter, 2011).

Perceived stress.—A 6-item version of the reliable and valid Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983) was used to measure perceptions of stress during the last month. These six items were selected based on earlier studies containing English and Spanish translations (Lobel, 1994; Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999; Zambrana et al., 1997); findings using this version of the scale in the SHARE dataset have been previously published (Campos et al., 2007). Participants rated their perceived stress using 4-point Likert-type scales (0 = *never*, 3 = *all of the time*). High average scores reflect greater perceived stress. In this study, reliability for the shortened scale was .75 for participants interviewed in Spanish and .64 for participants interviewed in English.

Pregnancy anxiety.—This 6-item scale measured sources of anxiety that were pregnancy-specific (e.g., I am concerned about having a hard or difficult labor/delivery; I worry about how my baby is growing *in utero*). Participants rated these items using 4-point Likert-type scales (0 = *never*, 3 = *all of the time*). This scale was developed for use in pregnancy

¹The ARSMA-II-SV may also be used to consider Anglo orientation and Mexican orientation separately. The U.S. Orientation scoring used in the present study was appropriate for the primary interest of the current study to examine the overall influence of acculturation, which may involve both the adoption of new culture and changes in one's original cultural orientation.

research (Rini et al., 1999) and is reliable in English and Spanish. In this study, the measure had a reliability of .81 for participants interviewed in Spanish and .80 for participants interviewed in English. Higher average ratings indicated greater pregnancy anxiety.

Family Support.—This 8-item scale measured perceived familial support (e.g., I know that my family will always be there for me should I need them). Participants responded using 4-point Likert-type scales (0 = strongly disagree; 3 = strongly agree). Family itself was not defined for the participant, allowing them to ascribe their perception of family. This was adapted from the Provisions of Social Relationships Inventory to assess familial support (Turner, Frankel, & Levin, 1983), and was reliable ($\alpha = .96$) in assessing family social support in pregnant populations (Turner, Sorenson, & Turner, 2000). Higher average scores indicated greater family support.

Analyses Overview

We tested a Bayesian multilevel structural equation model in *Mplus* 8.3 to examine associations among U.S. orientation, birth weight, DBP, SBP, stress (perceived stress and pregnancy anxiety), and family support. This approach is robust to missing data and non-normal distributions (Asparouhov & Muthén, 2010). All primary analyses controlled for maternal age, previous number of childbirths, birthplace (FB or USB), smoking status, and alcohol use. Gestational age at birth was included as a covariate to birth weight, making the outcome a measure of fetal growth. Blood pressure was measured at the within-subjects level (i.e., level 1). Thus, we examined individual mean levels of BP as well as individual BP trajectories across pregnancy. These slopes and intercepts were used at level 2 as predictors of fetal growth.

The level-1 predictor variable (gestational age at BP measurements) was person-mean centered, and all continuous level-2 predictor variables (U.S. orientation, perceived stress, pregnancy anxiety, family support, maternal age, previous number of childbirths, and gestational age at birth) were grand-mean centered. Separate models examined DBP and SBP as mediators between U.S. orientation and fetal growth. For each analysis, we utilized a first run to ensure convergence within 5,000 iterations. We then used a follow-up analysis with 10,000 first burn iterations to verify convergence. Convergence was verified following recommendations by (Asparouhov & Muthén, 2010). All analyses showed good convergence criteria with final PSR less than 1.01 and no significant Kolmogorov-Smirnov posterior distribution correlations.

Results

Descriptive and bivariate statistics

There were significant differences by birthplace in U.S. orientation, maternal age, family support, mean DBP and SBP across pregnancy, perceived stress, and birth weight (see Table 1). Maternal age was inversely correlated with length of gestation, perceived stress, and pregnancy anxiety (Table 2). U.S. orientation was positively correlated with mean SBP and DBP. U.S. orientation and DBP were inversely associated with maternal age and birth weight. SBP and DBP were inversely correlated with length of gestation.

Primary analyses

Systolic Blood Pressure.—There was a general increase in SBP across the course of pregnancy ($B = 0.156$, 95% BCI = 0.009, 0.303; Figure 1). This increase did not vary by perceived stress, pregnancy anxiety, or family support. U.S. orientation was not associated with mean SBP ($B = 0.177$, 95% BCI = 0.265, 0.629) or SBP slope ($B = 0.012$, 95% BCI = -0.005 , 0.029). As neither mean SBP ($B = 0.001$, 95% BCI = -0.003 , 0.006) nor SBP slope ($B = -0.072$, 95% BCI = -0.265 , 0.119) were associated with birth weight, there were no significant indirect associations between U.S. orientation and birth weight as a function of SBP. This model accounted for 24% (95% BCI = 21.2% to 27.7%) of the variance in birth weight.

Diastolic Blood Pressure.—In the DBP model (Figure 2), there was an increase in DBP across pregnancy ($B = 0.207$, 95% BCI = 0.085, 0.326) that was moderated by levels of U.S. orientation ($B = 0.015$, 95% BCI = 0.001, 0.028). At high levels of U.S. orientation (+1 *SD*) there was an increased slope in DBP across pregnancy ($B = 0.238$, 95% BCI = 0.119, 0.352); however, at low levels of U.S. orientation (-1 *SD*) this slope was attenuated ($B = 0.176$, 95% BCI = 0.043, 0.305). The DBP slope across pregnancy was inversely associated with birth weight, controlling for length of gestation ($B = -0.260$, 95% BCI = -0.502 , -0.041). Overall, U.S. orientation had a modest, but significant, indirect effect on birth weight (IND = -0.004 , 95% BCI = -0.010 , -0.001), that included a nonsignificant indirect effect through mean DBP and a significant indirect effect through DBP slope. This model accounted for 26% (95% BCI = 22.0% to 29.6%) of the variance in birth weight.

Discussion

This study is the first to link cardiovascular functioning to U.S. acculturation as a mechanism impacting Latina pregnancy outcomes. Acculturation has been associated with increased cardiovascular disease in Latino populations (Daviglius et al., 2012) potentially due, in part, to acculturation-related stress (Kasirye et al., 2005; Zambrana et al., 1997) and the impact of stress on the cardiovascular system (Marwaha, 2022). The present results provide important new evidence that Latinas who had higher levels of U.S. orientation also had DBP trajectories during pregnancy associated with less favorable birth outcomes.

In the present study, stress and family support measures were not significantly associated with U.S. orientation, BP, and pregnancy outcomes. Past research has shown that the perceptions and effects of psychosocial variables change over the course of pregnancy (Glynn, Schetter, Wadhwa, & Sandman, 2004; Glynn, Wadhwa, Dunkel-Schetter, Chicz-Demet, & Sandman, 2001) but psychosocial measures were only assessed at a single timepoint in SHARE. Nuanced changes in stress and family support that could be related to U.S. acculturation may have been missed. Future research needs to consider a more sophisticated interplay of social experience, cardiovascular functioning, and pregnancy outcomes.

It is also possible that U.S. acculturation has effects on cardiovascular functioning relevant to pregnancy that are independent of the psychosocial processes assessed in the present study. That is, the long term process of U.S. acculturation (Padilla & Perez, 2003; Schwartz

et al., 2010), which involves the difficulties of adapting to a devalued ethnic minority status for Latinas, may have affected the functioning of the cardiovascular system, perhaps through repeated stress responses or allostatic load (McEwen, 2004). Such impact may not be evident in associations between current cardiovascular functioning and proximal psychosocial stress. Consistent with this, past research has found that a lifetime of discrimination stresses experienced by African Americans affects cardiovascular functioning (Gee, Walsemann, & Brondolo, 2012; Geronimus, 1992, 1996) and that childhood experiences of racism, but not adulthood experiences, interact with BP to predict pregnancy outcomes (Hilmert et al., 2014). To best understand the impact of U.S. acculturation on physiology, researchers should consider related stress experiences over the life course.

A possible limitation of this study is the sample's restricted variance on the U.S. orientation measure. Three quarters of the sample (74.6%) were FB and reported low levels of U.S. orientation (Table 1). In a sample with a wider range of U.S. acculturation experiences future research can consider whether adoption of a new culture and loss of one's original culture are differentially associated with pregnancy outcomes. Also, this sample lacked variability in SES (see Kasirye et al., 2005), which was not included in the present model. Despite these potential limitations, we were able to leverage continuous measures of acculturation, BP, and pregnancy outcomes to detect theoretically consistent and meaningful patterns. Future studies that focus on the many ways in which U.S. acculturation unfolds and intersects with Latino experience in ways that may impact blood pressure can build on the findings of this work. Furthermore, future research should consider how other acculturation-related changes in physiology, including immune and endocrine parameters (Scholaske, Wadhwa, & Entringer, 2021) may be contributing to the association between DBP and fetal growth.

Acculturation to the U.S. is known to be a significant risk factor for cardiovascular health, and now this work connects Latina pregnancy to this pattern. In the future, awareness of a woman's acculturation and DBP changes during pregnancy may help to better identify those at risk of having lower birth weight babies. It is also possible that targeting the cardiovascular functioning of more acculturated Latinas during pregnancy via BP-related interventions such as relaxation techniques or medication could help mitigate rates of low birth weight deliveries. Future studies may also want to consider whether aspects of Latino culture that may provide health advantages (Campos, Yim, & Busse, 2018) can be recovered and benefit U.S. acculturated Latina pregnancies. Altogether, this research suggest that cardiovascular functioning is a promising new avenue for understanding the role of the socio-cultural environment in pregnancy health generally and in ethnic-minority experience specifically. We hope researchers are inspired by these findings to pursue future research on this topic; it is needed to arrive at a comprehensive understanding of the biopsychosocial nature of health.

Acknowledgments

This publication was made possible by grant numbers 5RO1 ES09867-03 and P30 ES05707 from the National Institute of Environmental Health Sciences (NIEHS) and National Institute for Occupational Safety and Health (NIOSH), Cooperative Agreement #1 U50 OH07550.

We would also like to express our appreciation to the OB-GYN Group of San Joaquin General Hospital, and staff members at the Healthy Beginnings and Community Health clinics affiliated with SJGH for their cooperation and willingness to let U.S. work alongside of them.

Finally, we would like to acknowledge the 1,024 Latina women who contributed their time and data to the SHARE study.

References

- Abraido-Lanza AF, Dohrenwend BP, Ng-Mak DS, & Turner JB (1999). The Latino mortality paradox: a test of the "salmon bias" and healthy migrant hypotheses. *American Journal of Public Health*, 89(10), 1543–1548. [PubMed: 10511837]
- Asparouhov T, & Muthén B (2010). Bayesian analysis using Mplus: Technical implementation. Los Angeles: Muthén & Muthén. www.statmodel.com.
- Callister LC, & Birkhead A (2002). Acculturation and perinatal outcomes in Mexican immigrant childbearing women: an integrative review. *The Journal of perinatal & neonatal nursing*, 16(3), 22–38. [PubMed: 12472187]
- Campos B, Schetter CD, Abdou CM, Hobel CJ, Glynn LM, & Sandman CA (2008). Familialism, social support, and stress: positive implications for pregnant Latinas. *Cultur Divers Ethnic Minor Psychol*, 14(2), 155–162. doi: 10.1037/1099-9809.14.2.155 [PubMed: 18426288]
- Campos B, Schetter CD, Walsh JA, & 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.
- Campos B, Yim IS, & Busse D (2018). Culture as a Pathway to Maximizing the Stress-Buffering Role of Social Support. *Hispanic journal of behavioral sciences*, 0739986318772490.
- Cedillo YE, Bertrand B, Baker E, Cherrington AL, Beasley TM, & Fernandez JR (2021). Assimilation, Acculturation, and Allostatic Load in U.S.- and Foreign-Born Hispanics. *J Immigr Minor Health*, 23(1), 35–44. doi:10.1007/s10903-020-01012-7 [PubMed: 32333289]
- Cohen S, Kamarck T, & Mermelstein R (1983). A global measure of perceived stress. *Journal of Health & Social Behavior*, 24(4), 385–396. [PubMed: 6668417]
- 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.
- D'Anna-Hernandez KL, Hoffman MC, Zerbe GO, Coussons-Read M, Ross RG, & Laudenslager ML (2012). Acculturation, maternal cortisol and birth outcomes in women of Mexican descent. *Psychosomatic Medicine*, 74(3), 296. [PubMed: 22366584]
- Daviglus ML, Talavera GA, Avilés-Santa ML, Allison M, Cai J, Criqui MH, ... Stamler J (2012). Prevalence of Major Cardiovascular Risk Factors and Cardiovascular Diseases Among Hispanic/Latino Individuals of Diverse Backgrounds in the United States. *JAMA*, 308(17), 1775–1784. doi:10.1001/jama.2012.14517 [PubMed: 23117778]
- Dunkel Schetter C (2009). Stress processes in pregnancy and preterm birth. *Current Directions in Psychological Science*, 18(4), 205–209.
- Dunkel Schetter C (2011). Psychological science on pregnancy: Stress processes, biopsychosocial models, and emerging research issues. *Annual Review of Psychology*, 62, 531–558.
- Gee GC, Walsemann KM, & Brondolo E (2012). A life course perspective on how racism may be related to health inequities. *Am J Public Health*, 102(5), 967–974. doi:10.2105/AJPH.2012.300666 [PubMed: 22420802]
- Geronimus AT (1992). The weathering hypothesis and the health of African-American women and infants: evidence and speculations. *Ethn Dis*, 2(3), 207–221. [PubMed: 1467758]
- Geronimus AT (1996). Black/white differences in the relationship of maternal age to birthweight: a population-based test of the weathering hypothesis. *Soc Sci Med*, 42(4), 589–597. [PubMed: 8643983]
- Glynn LM, Schetter CD, Wadhwa PD, & Sandman CA (2004). Pregnancy affects appraisal of negative life events. *J Psychosom Res*, 56(1), 47–52. doi:10.1016/S0022-3999(03)00133-8 [PubMed: 14987963]

- Glynn LM, Wadhwa PD, Dunkel-Schetter C, Chicz-Demet A, & Sandman CA (2001). When stress happens matters: effects of earthquake timing on stress responsivity in pregnancy. *Am J Obstet Gynecol*, 184(4), 637–642. [PubMed: 11262465]
- Grindheim G, Estensen M-E, Langesaeter E, Rosseland LA, & Toska K (2012). Changes in blood pressure during healthy pregnancy: a longitudinal cohort study. *Journal of hypertension*, 30(2), 342–350. [PubMed: 22179091]
- Hilmert CJ, Dominguez TP, Schetter CD, Srinivas SK, Glynn LM, Hobel CJ, & Sandman CA (2014). Lifetime racism and blood pressure changes during pregnancy: Implications for fetal growth. *Health Psychol*, 33(1), 43–51. doi:10.1037/a0031160 [PubMed: 23379383]
- Hilmert CJ, Schetter CD, Dominguez TP, Abdou C, Hobel CJ, Glynn L, & Sandman C (2008). Stress and blood pressure during pregnancy: Racial differences and associations with birthweight. *Psychosomatic Medicine*, 70(1), 57–64. doi:10.1097/PSY.0b013e31815c6d96 [PubMed: 18158373]
- Kasirye OC, Walsh JA, Romano PS, Beckett LA, Garcia JA, Elvine-Kreis B, ... Schenker MB (2005). Acculturation and its association with health-risk behaviors in a rural Latina population. *Ethnicity & Disease*, 15(4), 733–739. [PubMed: 16259501]
- Lobel M (1994). Conceptualizations, measurement, and effects of prenatal maternal stress on birth outcomes. *J Behav Med*, 17(3), 225–272. [PubMed: 7932680]
- Markides KS, & Coreil J (1986). The health of Hispanics in the southwestern United States: an epidemiologic paradox. *Public health reports*, 101(3), 253. [PubMed: 3086917]
- Marwaha K (2022). Examining the Role of Psychosocial Stressors in Hypertension. *J Prev Med Public Health*, 55(6), 499–505. doi:10.3961/jpmph.21.266 [PubMed: 36475315]
- McEwen BS (2004). Protection and damage from acute and chronic stress: allostasis and allostatic overload and relevance to the pathophysiology of psychiatric disorders. *Ann N Y Acad Sci*, 1032, 1–7. doi: 1032/1/1 [pii] 10.1196/annals.1314.001 [PubMed: 15677391]
- Montoya-Williams D, Williamson VG, Cardel M, Fuentes-Afflick E, Maldonado-Molina M, & Thompson L (2020). The Hispanic/Latinx perinatal paradox in the United States: a scoping review and recommendations to guide future research. *Journal of Immigrant and Minority Health*, 1–14.
- Nino MD, & Hearne BN (2022). Dimensions of acculturation and biological dysregulation among Latina/os: the role of ethnic background, gender, and immigrant generation. *Ethn Health*, 27(4), 963–979. doi:10.1080/13557858.2020.1821175 [PubMed: 32931321]
- Padilla AM, & Perez W (2003). Acculturation, social identity, and social cognition: A new perspective. *Hispanic Journal of Behavioral Sciences*, 25(1), 35–55.
- Pivarnik JM, Szymanski LM, & Conway MR (2016). The elite athlete and strenuous exercise in pregnancy. *Clinical Obstetrics and Gynecology*, 59(3), 613–619. [PubMed: 27398878]
- Preeclampsia and Eclampsia. (2013). In Harvard Medical School, Harvard Medical School Health Topics A-Z. Boston, MA: Harvard Health Publications.
- Rini C, Dunkel-Schetter C, Wadhwa PD, & Sandman CA (1999). Psychological adaptation and birth outcomes: The role of personal resources, stress, and sociocultural context in pregnancy. *Health Psychology*, 18(4), 333–345. [PubMed: 10431934]
- Ruiz JM, Steffen P, & Smith TB (2013). Hispanic mortality paradox: a systematic review and meta-analysis of the longitudinal literature. *American Journal of Public Health*, 103(3), e52–e60.
- Scholaske L, Wadhwa PD, & Entringer S (2021). Acculturation and biological stress markers: A systematic review. *Psychoneuroendocrinology*, 132, 105349. doi: 10.1016/j.psyneuen.2021.105349 [PubMed: 34246155]
- Schwartz SJ, & Unger J (2017). *The Oxford handbook of acculturation and health*. Oxford University Press.
- Schwartz SJ, Unger JB, Zamboanga BL, & Szapocznik J (2010). Rethinking the concept of acculturation: Implications for theory and research. *American Psychologist*, 65(4), 237. [PubMed: 20455618]
- Steffen PR, Smith TB, Larson M, & Butler L (2006). Acculturation to Western society as a risk factor for high blood pressure: a meta-analytic review. *Psychosom Med*, 68(3), 386–397. doi: 10.1097/01.psy.0000221255.48190.32 [PubMed: 16738069]

- Turner RJ, Frankel BG, & Levin DM (1983). Social support: Conceptualization, measurement, and implications for mental health. *Research in community & mental health*.
- Turner RJ, Sorenson AM, & Turner JB (2000). Social contingencies in mental health: A seven-year follow-up study of teenage mothers. *Journal of Marriage and Family*, 62(3), 777–791.
- Zambrana RE, Scrimshaw SC, Collins N, & Dunkel-Schetter C (1997). Prenatal health behaviors and psychosocial risk factors in pregnant women of Mexican origin: the role of acculturation. *Am J Public Health*, 87(6), 1022–1026. [PubMed: 9224189]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Summary Statement:

This study reports novel evidence identifying increased blood pressure during pregnancy as a possible reason why Latina-Americans experience increased risk for adverse pregnancy outcomes, particularly lower birth weight, with more U.S. acculturation. Considering cultural orientation and blood pressure of Latina-American women during pregnancy may help identify pregnancies that are at risk for adverse outcomes. Future studies that focus on the nature of the association between U.S. acculturation and higher blood pressure during pregnancy may contribute to the development of targeted interventions that promote healthy pregnancies.

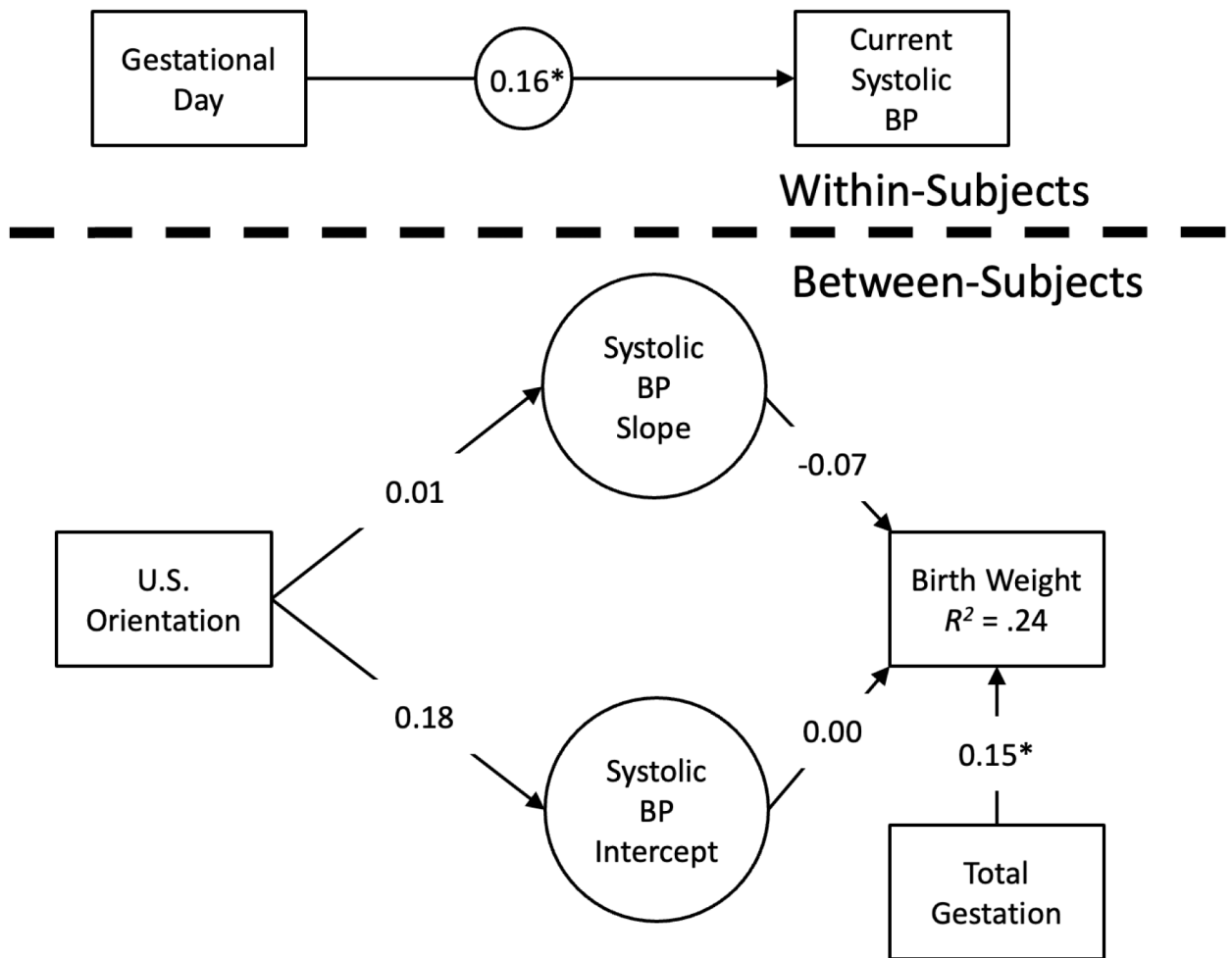


Figure 1. Multilevel model of systolic blood pressure across pregnancy as a mediator of the effects of stress and acculturation on fetal growth.

Note. Family support, gross family income, age of the mother at birth, mothers place of birth, smoking status, alcohol use, and previous number of children were included as covariates in the model but are omitted here for clarity. BP = blood pressure. Gestational Day is the point in gestation at which blood pressure was measured. The within-subjects coefficient represents average individual SBP trajectories across pregnancy (i.e., the MLM random slope of SBP across time).

* 95% Bayesian Credibility Interval does not include 0

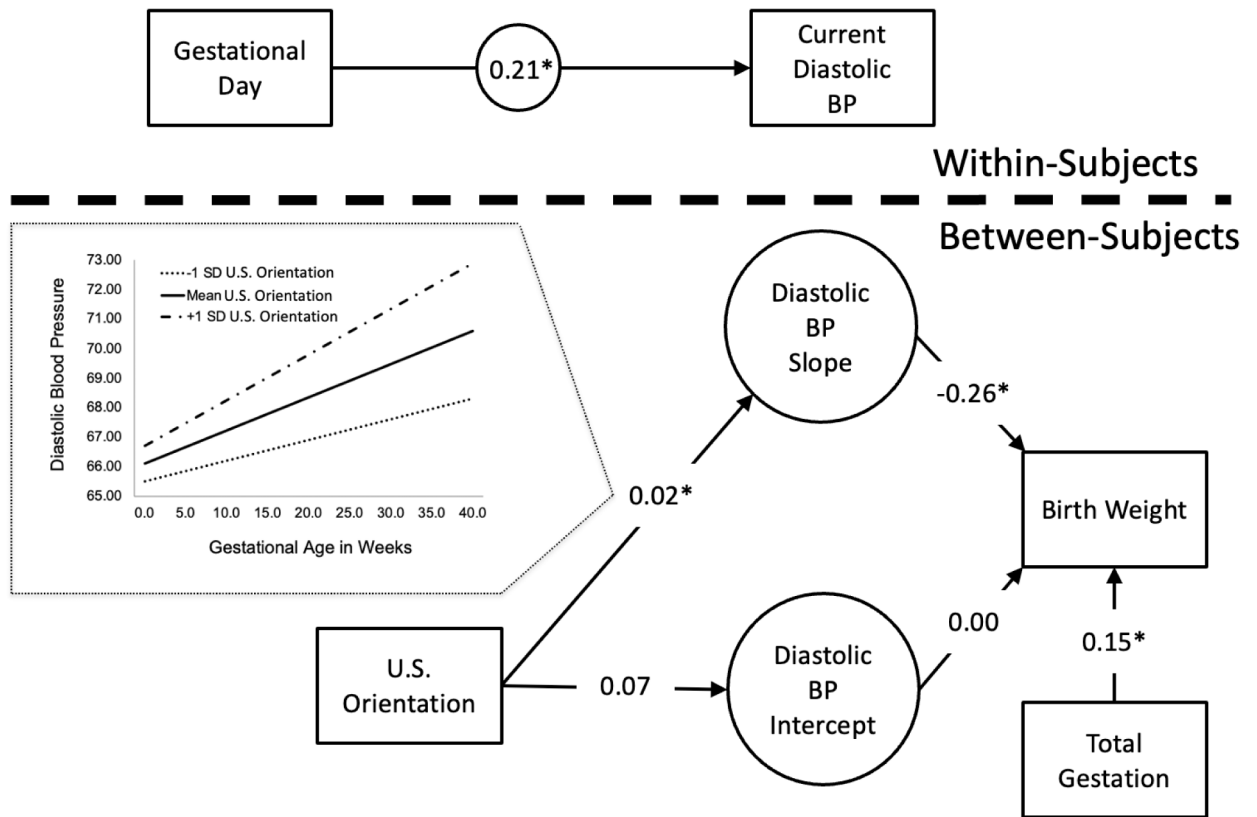


Figure 2. Multilevel model of diastolic blood pressure across pregnancy as a mediator of the effects of stress and acculturation on fetal growth.

Note. Family support, gross family income, age of the mother at birth, mothers place of birth, smoking status, alcohol use, and previous number of children were included as covariates in the model but are omitted here for clarity. BP = blood pressure. Gestational Day is the point in gestation at which blood pressure was measured. The within-subjects coefficient represents average individual DBP trajectories across pregnancy (i.e., the MLM random slope of DBP across time).

* 95% Bayesian Credibility Interval does not include 0

Table 1.Means and *SD* of study variables.

Variables	FB n = 754 Mean (SD)	USB n = 257 Mean (SD)
Mothers age at time of birth	26.12 (6.19)	22.14 (5.21) **
Annual income (in thousands)	41.27 (26.30)	38.84 (25.10)
Length of gestation in weeks	39.68 (2.23)	39.44 (2.13)
Birth weight in kilograms	3.39 (0.56)	3.29 (0.51) *
Previous number of births	2.25 (8.10)	2.24 (7.91)
Mean SBP	109.17 (9.92)	112.61 (9.91) **
Mean DBP	66.00 (7.26)	67.47 (7.45) **
Pregnancy Anxiety	1.39 (0.85)	1.42 (0.82)
Family Support	2.07 (0.36)	2.19 (0.44) **
Perceived Stress	1.21 (0.54)	1.11 (0.70) *
U.S. Orientation	-2.38 (1.14)	1.50 (1.67) **

Note. For *t*-test comparisons between groups ** $p < 0.01$, * $p < 0.05$. FB = foreign born Latinas, USB = United States born Latinas, SBP = systolic blood pressure, and DBP = diastolic blood pressure.

Table 2.

Correlation Table.

	U.S. Orientation	Maternal Age	Adjusted Income	Parity	Pregnancy Anxiety	PSS	Support	Gestational Age	BWT	Mean SBP
Maternal Age	-.250**									
Adjusted Income	-.076*	-.049								
Parity	-.051	.275**	-.064*							
Pregnancy Anxiety	-.019	-.156**	.046	-.079*						
PSS	.043	-.136**	-.031	.008	.122**					
Family Support	.151**	-.034	-.031	.012	.008	-.158**				
Gestation Age	-.041	-.083**	.003	-.059	.005	.037	-.060			
Birthweight	-.068*	.056	-.040	.039	-.031	-.002	-.073*	.589**		
Mean SBP	.147**	.182**	-.025	.034	-.054	-.066*	.100**	-.087**	-.040	
Mean DBP	.097**	.153	-.040	.053	.019	-.043	.109**	-.074*	-.088**	.717**

Note. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). PSS = Perceived Stress Scale, BWT = birthweight, SBP = systolic blood pressure, and DBP = diastolic blood pressure.