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a mixed-methods approach to understanding stress and resilience in Latina mothers

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Anthropology

by

Delaney Anne Knorr

2024

ABSTRACT OF THE DISSERTATION

Embodied experiences:

a mixed-methods approach to understanding stress and resilience in Latina mothers

by

Delaney Anne Knorr

Doctor of Philosophy in Anthropology

University of California, Los Angeles, 2024

Professor Molly Mauer Fox, Chair

In the last decade, maternal and fetal health patterns have worsened in the United States. Within this context, Latina women are experiencing escalating stressors, including greater levels of discrimination and political victimization. Stressors can become embodied (or 'get under the skin') through psychological distress. When this occurs during pregnancy, stress embodiment can lead to disparities in birth outcomes through pathways that have yet to be elucidated. In order to study these intergenerational cycles of health disparities and how to interrupt them, I use a mixed-methods approach and offer a richer description of stress embodiment and cultural resilience. This dissertation utilizes an innovative confluence of anthropological frameworks and biomolecular techniques, drawing from three data sources (Mothers' Cultural Experiences Project Waves 1 and 2, and the Supporting Mothers Project) and representing the experiences of almost 300 Latina women living in Southern California. Through qualitative interviewing, I explore the unique

perinatal stressors of first-time mothers who are 1.5/2nd generation Mexican (Chapter 5). With quantitative modeling, I replicate the finding that discrimination impacts psychological distress during pregnancy (Chapter 4). I use state-of-the-art immunoaffinity assays from prenatal plasma samples to show how psychological distress in early-gestation relates to dampened levels of placental extracellular vesicles (Chapter 2). This reflects diminished levels of feto-placental communication and, potentially, a proximate explanation of the trends connecting stress and high rates of low birth weight and preterm birth. In seeking to interrupt health disparities, I assess social support as a major factor in resilience. Specifically, I take an intergenerational approach to show that grandmothers improve maternal psychological well-being and buffer stress during pregnancy (Chapters 3-4). By exploring allocare during the prenatal period, I contribute to the theoretical integration of cooperative breeding theory and the developmental origins of health and disease. Moreover, I qualitatively investigate the resilience women construct from their bicultural identities and the cultural barriers around asking for help (Chapter 5). Altogether, this dissertation offers a multifaceted exploration of perinatal health that contributes to health equity research by using a mix of quantitative and qualitative methods to better understand the experiences of stress and resilience among Latina women.

The dissertation of Delaney Anne Knorr is approved.

Abigail Winslow Bigham

Brooke Anne Scelza

Hsian-Rong Tseng

Molly Mauer Fox, Committee Chair

University of California, Los Angeles

2024

To my mother, Geri

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Wiley, K.; Kwon, D.; **Knorr, D.A.;** and Fox, M. (2023) "Regulatory T-cell phenotypes in prenatal psychological distress." *Brain, Behavior and Immunity.*

Kwon, D.; **Knorr, D.A.;** Wiley, K.; Long, S.L.; and Fox, M. (2023) "Association of pica with cortisol and inflammation among Latina pregnant women." *American Journal of Human Biology.*

Chua, K.J*.; **Knorr, D.A*.**; Jimenez, J.; Francia, A.; Rojas, V.; Garcia, J.I.; Fox, M. (2023) "The role of individual and subjective neighborhood cultural identity and social attitudes on maternal mental health among pregnant Latina women." *Journal of Racial and Ethnic Health Disparities.* ** = sharing first authorship*

Wiley, K., **Knorr, D.A.**; Chua, K.J., Garcia, S; and Fox, M. (2023) "Sociopolitical stressors are associated with psychological distress in a cohort of Latina women during early pregnancy." *Journal of Community Psychology.* doi: 10.1002/jcop.23065

Fox, M.; **Knorr, D.A.**; Wiley, K.; Kwon, D.; Parrish, M. (2023) "How prenatal cortisol levels relate to grandmother-mother relationships among a cohort of Latina women." *American Journal of Human Biology.* doi: 10.1002/ajhb.23883.

Knorr, D.A.; Fox, M. (2022) "An evolutionary perspective on the association between grandmother-mother relationships and maternal mental health among a cohort of pregnant Latina women." *Evolution of Human Behav*ior doi: 10.1016/j.evolhumbehav.2022.10.005.

Hagen, R., **Knorr, D.A.,** Li, S., Mensing, A., & Scelza, B. (2022). "Staying alive enhances both women's and men's fitness." *Behavioral and Brain Sciences*. doi:10.1017/S0140525X22000553

Presentations (selected)

49th Annual Meeting of Human Biology Association (HBA)   March 20, 2024
   "Maternal immune tolerance (regulatory T-cells) is positively correlated with a novel biomarker of feto-placental communication (extracellular vesicles) during pregnancy"
   (Poster; Los Angeles, CA)

California Science Education (CASE) Conference   October 21, 2023
   "Ancestry and Evolution: The Meaning of Race"
   (3-hour interactive short-course co-presented with Dr. Zachary Cue; Palm Springs, CA)

International Society for Evolution, Medicine & Public Health   August 15, 2023
   "How Prenatal Psychological Distress Relates to a Novel Biomarker of Placental Dynamics"
   (Oral Presentation; UC Irvine)

California Workshop on Evolutionary Social Science (CWESS)   May 6, 2023
   "Maternal Loneliness in Early and Late Gestation Has Differential Effects on Offspring Birth Weight Among a Cohort of Pregnant Latina Women"
   (Oral Presentation; UC Merced)

International Society for Evolution, Medicine & Public Health (ISEMPH)   July 8, 2022
   "Grandmothers buffer the relationship of discrimination and psychological distress"
   (Oral Presentation; Lisbon, Portugal)

California Workshop on Evolutionary Social Science (CWESS)   May 7, 2022
   "Grandmaternal influence on breastfeeding rates among primiparous women in the U.S."
   (Oral Presentation; CSU Fullerton)

47th Annual Meeting of Human Biology Association (HBA)   March 23, 2022
   "The effect of geographic proximity to family in a cohort of first-time Latina mothers."
   (Poster; presented virtually)

Chapter 1: Contextualizing Latina Perinatal Health Disparities

1. Introduction

In this dissertation, I consider how evolution shapes our bodies, minds, and social relationships in ways that impact the embodiment of stress during pregnancy. Medical anthropologist Thomas Csordas (1990) formalized the concept of embodiment to describe how social experiences can impact bodies. Biology transcends genetics in that many biological systems respond to the environment and can be molded by socio-politico-cultural experiences, such as medicalization or marginalization. Thus, embodiment can be an explanatory system for how social inequality leads to health disparities (Gravlee, 2009). Stressors (like trauma and discrimination) and psychological distress (like anxiety and depression) can 'get under the skin' in ways associated with adverse birth outcomes (Wang et al., 2020). In this dissertation, I take an interdisciplinary approach to study the sociocultural and interpersonal factors during the perinatal period that impact maternal health. I use three distinct methods to ask how systems of psychosocial stressors, stress, and resilience during pregnancy influence mental health outcomes among Latina women living in Southern California. Given the strong connection between psychological distress and adverse birth outcomes already established in the literature (Grigoriadis et al., 2013, 2018; Grote et al., 2010), this dissertation adds to health equity research by evaluating the contributing factors and potential buffers of minority mental health disparities.

I integrate cultural anthropology, evolutionary biology, and health sciences by using a mixed-methods approach that examines stress, gestational biology, and intergenerational social relationships from the broadest (societal) to the smallest (placental molecular biology) level (Figure 1.1). Each aim of this dissertation is thematically linked by exploring different

intergenerational connections of health, stress, and culture between grandmother, mother, and offspring (Figure 1.2).

Figure 1.1: Aims of This Dissertation
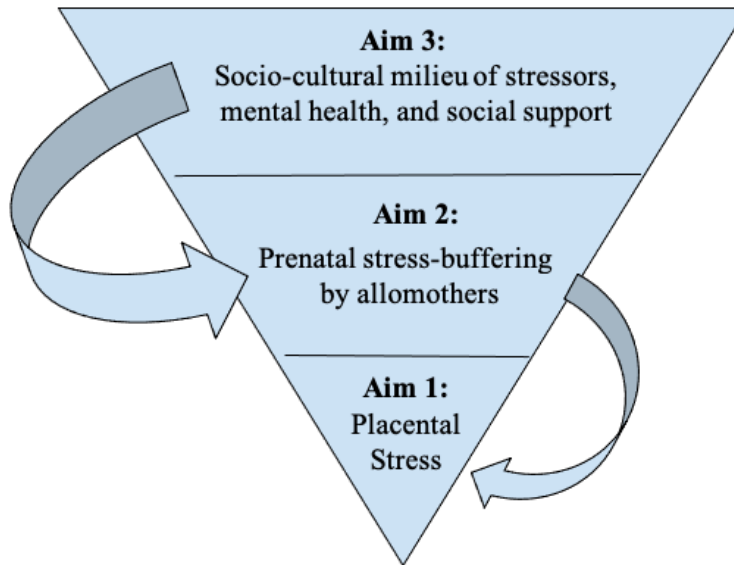
Aim 1: Evaluate the associations of maternal psychosocial stress and a novel biomarker of placental stress. By using cutting-edge techniques in molecular biology, I will evaluate the quantity of placental extracellular vesicles (a key player in feto-maternal communication) in relation to psychosocial stress. No work has yet investigated this relationship. This aim explores a potential proximate mechanism of the intergenerational embodiment of stress.

Aim 2: Assess the influence of grandmothers on prenatal maternal psychology. Given the positive correlation between maternal chronic stress and offspring morbidity, I explore if grandmothers buffer maternal stress during pregnancy or otherwise influence maternal psychology. This aim is motivated by evolutionary theory, which suggests that improving maternal wellbeing during gestation would potentially improve offspring fitness outcomes and by extension grandmaternal inclusive fitness.

Aim 3: Explore the intergenerational transmission of stress, social support, and reproductive knowledge among first-time mothers. Research indicates that many health outcomes, including mental health, are worse for the 1.5 and 2nd generation compared to 1st or 3rd generation individuals. Through conducting person-centered interviews, I will explore the stress, social support, and mental health of Mexican-American first-time mothers during the start of the COVID-19 pandemic. This aim privileges the experiences of women in their own words, and is important for framing Aim 1 and 2.

Figure 1.2: The Intergenerational Links Between Aims

Aim 3: Socio-cultural milieu of stressors, stress, and social support

Grandmother

Aim 2: Prenatal Stress-Buffering

Mother

Aim 1: Placental Embodiment of Stress

Offspring
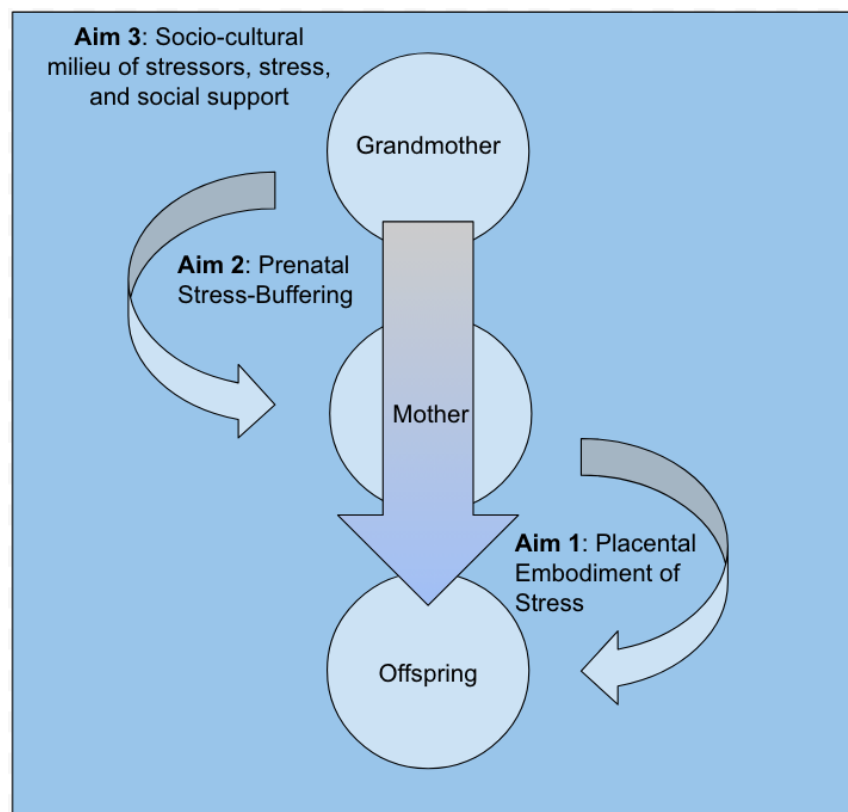
The epidemiological pattern connecting psychological distress during pregnancy to adverse birth outcomes has been robustly shown (Grigoriadis et al., 2013, 2018; Grote et al., 2010). However, the mechanistic process of this embodiment is unclear. It is hypothesized that the placenta, the temporary organ that develops during pregnancy and is responsible for all biological

material and information passing between the mother and fetus, is sensitive to perturbations of stress. To understand the proximate mechanisms of fetal stress exposure during pregnancy, there is a need to study placental changes directly. Unfortunately, the placenta is very difficult to study. To overcome this, I use novel biomolecular techniques to capture and quantify placental extracellular vesicles (pEVs). pEVs are lipid-bound particles released by placental cells into maternal circulation that play an important role in feto-maternal communication. They can be studied through minimally invasive maternal plasma samples. I explore the relationship of psychological distress and placental biology (represented by pEVs) in Chapter 2.

The cascade of biological changes associated with adverse birth outcomes are set off by social experiences. In this dissertation, I treat the stress that starts these cascades as a subjective, culturally-bound experience. Thus, I measure stress throughout with qualitative interviews and psychometric measures of the subjective experience. I use validated self-report questionnaires in Chapters 2, 3, and 4 to assess the *perceived* measures of discrimination, anxiety, and depression; as what an individual perceives of their reality is often more important than objective measures of their world (Glei et al., 2018). I use qualitative interviewing in Chapter 5 to delve into lived experiences in order to understand perinatal stress. By utilizing qualitative interviewing in tandem with subjective and biological measures of stress and resilience, this dissertation minimizes the limitations of one approach and offers a richer description of stress and stress-buffering experiences.

While much health research has focused on the negative biological ramifications of stressors like discrimination and acculturation (Cervantes et al., 2013; Fox et al., 2015; Fryer et al., 2020; Strahm et al., 2018), others have strived to promote more understanding of the resilience systems that help combat these disparities (Cheadle et al., 2020). For example, social support has

been shown to be protective against detrimental psychological and physical states, and to improve resilience (Reblin & Uchino, 2008; Suls & Wallston, 2003). Therefore, I seek to elucidate ways to interrupt cycles of intergenerational minority health disparities. In this dissertation, I study stress and resilience systems together. This provides a more comprehensive understanding of how individuals respond to psychosocial challenges. By including qualitative discussions and self-report measures of social support (Chapter 3-5), I explore a key aspect of human resilience.

Across many cultures, the primary source of social support and knowledge transfers during the perinatal period is from grandmothers (Scelza, 2009; Scelza & Hinde, 2019; Sear et al., 2000; Sear & Mace, 2008). While grandmothers have been shown to supply support in many ways to protect against infant mortality, there is no research addressing this support during pregnancy nor grandmothers' unique capacity for stress buffering. Evolutionary scholarship has focused on grandmothers as valued helpers (or 'allomothers') who have adaptive interests in supporting their grandoffspring at weaning. In Chapters 3 and 4, this dissertation examines allomothering from the (soon-to-be) grandmother during pregnancy, which is a period of the perinatal experience that is at least as vulnerable as weaning and brings about unique psychological and physiological challenges for the (soon-to-be) mother. The developmental origins of the health and disease framework highlights the connections and vulnerabilities between mother and offspring during pregnancy, which suggests evolutionary motivations for grandmaternal influence.

To further understand the experiences of perinatal Latina women living in Southern California, I conducted qualitative interviews with women who recently gave birth to their first child and who were 1.5 or 2nd generation Mexican. While 1st generation individuals were born outside of the U.S. and immigrated as adults, the often invisible 1.5 generation immigrated to the U.S. as children. Individuals who were born in the U.S. to immigrant parents are 2nd generation,

and each generation onwards is counted numerically (i.e., U.S.-born children to U.S.-born parents are 3rd generation, etc.). I used the cut-off of immigrating before the age of 12 to define the 1.5 generation participating in the research project presented in Chapter 5. This inclusion criteria is important because, as will be discussed later, these generations (1.5/2nd) tend to experience the greatest amount of discrimination, acculturative stress, and psychological distress compared to other generations (i.e., 1st and 3rd) (Cervantes et al., 2013; Finch et al., 2000; Pérez et al., 2008). Additionally, research is lacking on the 1.5 generation, whose unique experiences are often overlooked, despite facing distinct challenges compared to those who immigrate as adults. These women likely have the largest cultural distance from their parents, informing unique experiences surrounding the knowledge transfers and social support they receive. This chapter explores what help these women receive, how they receive it, and how they feel about it in order to create a richer context in which to describe maternal mental health and social support.

This dissertation broadly focuses on the lives of perinatal Latina women to explore their shared experiences of societal treatment and marginalization, such as discrimination and political victimization, and the consequences of that treatment. Thus, for Chapters 2-4, I use the term Latina as the participants were of varied cultural backgrounds, but linked by these shared experiences. Additionally, participants all identified as women and/or mothers; therefore, I do not use gender-neutral terms like 'Latinx' or 'Latine', but I do acknowledge the importance of these terms for inclusivity in other literatures. Chapter 5, which focuses on the cultural explorations of social support, requires a more granular understanding of the unique historical, cultural, and social experiences of the women sharing their stories. Thus, I filter the cohort of women participating in the study presented in Chapter 5 to those with heritage to and/or citizenship from Mexico for a more nuanced understanding of identity formation, family dynamics, and cultural practices.

2. Background

2.1 Why study pregnancy?

The perinatal period involves navigating through the multitude of physical, emotional, and psychological transformations that come with pregnancy, childbirth, and postpartum recovery. Pregnancy itself brings about psychological and physiological transitions, along with new forms of discrimination, financial strains, and medical systems. It can also be a period of vulnerability for the onset of maternal affective disorders, particularly depression and anxiety (Fishell, 2010). These new stressors, as well as existing stressors, may merge to create chronic stress, which can be significantly consequential for both maternal and fetal health.

Humans evolved to be sensitive to different environmental stimuli within individuals and intergenerationally (Lea et al., 2017). Much of our biology is responsive to our environment and remains flexible throughout our lifespan; however, there are critical/sensitive windows of development where more biological change occurs and the environment plays a larger role in shaping our phenotypes (Wells, 2014). During pregnancy, the fetus undergoes a sensitive window of development. The uterus provides a stable and controlled environment where the fetus can develop and grow, buffered from many external stressors. However, pregnancy also exposes the fetus to various elements of the outside world through the maternal body. The fetus can be influenced by maternal and external factors such as stress levels, diet, and toxins, which can have both short-term and long-term effects on offspring health and development (Godfrey et al., 2011). Since all information about the external environment is transmitted through the maternal body, it is important to study maternal stress during pregnancy from an intergenerational perspective.

2.2 Why use an intergenerational perspective?

Integrating intergenerational perspectives into minority obstetric health research allows for a comprehensive understanding of the complex factors contributing to health disparities. Prenatal exposures, maternal health status, and socio-economic conditions can link the health outcomes of the previous generation to the next. Understanding this phenomenon can inform strategies to promote health equity across generations.

Pregnancy is not only a period of new stressors and potential stress, but also a critical period of intergenerational transmission – both biologically and socially. Biologically, exposures of stress during pregnancy are intergenerational, as what influences the maternal body may set the developing offspring on a trajectory towards disease risk. The placenta is the interface of these two generations, as all biological material that will reach the fetus from the mother must first pass through the placenta. Thus, we must investigate the activity of the placenta directly during pregnancy to explore how health disparities can be transmitted intergenerationally.

Socially, pregnancy and the postpartum period are times during which women enter new family roles and require more help. Researchers have noted that, across many cultural settings in various global regions, the instrumental and informational support from grandmothers is especially consistent and high-quality (Chapman et al., 2021; Emmott & Mace, 2015; Leonetti et al., 2005; Scelza, 2009; Sear et al., 2000; Sear & Mace, 2008). Grandmothers are valuable allomothers because they often have more reproductive experience and expertise compared to other kin categories, such as the index offspring's older siblings. Research has long focused on the evolutionary importance of allomothers – especially during the weaning period. However, recent research has shown that grandmothers, with their breadth of experience and knowledge, are critical throughout the reproductive careers of mothers (who are their daughters and daughters-in-law). These critical periods include birth (Rosenberg & Trevathan, 2014) and breastfeeding (Myers et

al., 2021; Scelza & Hinde, 2019). Pregnancy is a vulnerable period where much learning and relationship change occurs and is also a period often left out in allomaternal research. Thus, there is a need to study allomother involvement during pregnancy through an evolutionary lens. Additionally, minority communities often have strong cultural and familial ties that influence health behaviors, beliefs, and practices across generations. Understanding these intergenerational dynamics is crucial for designing culturally sensitive and effective interventions to address obstetric health disparities.

2.3 Why ask these questions in a Latina cohort?

2.3.1 A Note on Terminology

The terms 'Hispanic' and 'Latino/a' serve as multifaceted labels, encompassing people with a variety of cultures, identities, and experiences within the United States. The term 'Hispanic' originates from collectivist social movements in the 1960s and '70s to draw attention to similar issues facing many groups residing in the U.S. with heritage to Mexico, Puerto Rico, Cuba, and/or other Central/South American countries, including discrimination in labor markets and school segregation (Noe-Bustamante et al., 2020; Schelenz & Freeling, 2019). In the 1990s, resistance to the term's connection to colonial Spain resulted in a new term ('Latino') to be used. The term 'Latino' first appeared in the U.S. Census in 2000, alongside 'Hispanic', which suggests the somewhat interchangeable nature of the two terms (Noe-Bustamante et al., 2020). According to the PEW Research Center, a majority (61%) of individuals under the 'Hispanic/Latino' label say they prefer 'Hispanic' to describe the *overall population* living in the U.S. compared to 29% preferring the term 'Latino' and 4% preferring 'Latinx' (Noe-Bustamante et al., 2020). Additionally, 48% of respondents indicate a preference for identifying *themselves* by their country of origin rather than using terms such as Latino, Latina, Latinx, Latine, or Hispanic (Passel, 2023).

Ultimately, the term 'Latino' encompasses individuals from various ethnicities and cultural backgrounds, fostering a sense of inclusivity and solidarity within diverse communities to acknowledge the shared experiences and common struggles faced by people of Latin American descent living in the U.S. This dissertation will utilize the term 'Latino/a' to spotlight the shared experiences of discrimination and marginalization within the U.S., delving into their effects on health outcomes. Despite the importance of gender-neutral terms in academic research, I will use the term 'Latino' for general trends among all people within this ethnic category. Additionally, I will use the term 'Latina' for all birthing people given the low endorsement of gender-neutral terms like 'Latinx' and 'Latine' in the general population (Noe-Bustamante et al., 2020) and the fact that this is the most relevant term for the cohorts included in this dissertation (who all identified as women).

2.3.2 Public Health Trends in Psychological Distress Among Latino Adults

Non-communicable diseases are on the rise, and the Centers for Disease Control and Prevention (CDC) have identified elevated prevalence of adverse social determinants of health and health-related social needs among Native American, Black, and Latino adults compared with non-Latino White (henceforth referred to as White) adults (Town et al., 2024). The recent Trump administration (2016-2020) and the COVID-19 global public health emergency (2020-2023) led to (1) increased discrimination and negative sentiment against Latino adults (Hswen et al., 2020; PEW Research Center, 2018), and (2) widening poverty and food insecurity gaps between Latino and White individuals (González, 2020; Krogstad & Lopez, 2020; U.S. Census Bureau, 2021), respectively. Additionally, Latinos often experience unique socio-economic stressors, including discrimination and acculturation (the multidimensional process of retaining and losing various cultural identities) (Cervantes et al., 2013; Fox et al., 2015; Fox, 2021; Lara-Cinisomo et al., 2016).

In multiple studies conducted between 2020-2022, Latino adults possessed higher prevalence of both severe and moderate psychological distress than any other ethnic group (Pasquini & Keeter, 2022; Wen et al., 2023). These issues are important to consider because Latinos are the largest minority group in the U.S. (Buriel, 2012; Lopez, 2022; U.S. Census Bureau, 2022) and the largest of any demographic group in California (Public Policy Institute of California, 2020). Additionally, Latina women specifically experience rates of psychological distress 20% higher than White women (CDC, 2019). Latina women are also more likely than Latino men to experience depressive symptoms (Alegria et al., 2007; Wassertheil-Smoller et al., 2014).

Latina women face a disproportionate burden of depression perinatally. For example, depression symptoms are twice as common among Latina women compared to their White counterparts, 2-6 weeks postpartum (Howell et al., 2005). Epidemiologically, the U.S. broadly (Dolbier et al., 2013) and Los Angeles specifically (LA Best Babies Network, 2009) report elevated rates of postpartum depression among Latina women compared to White women (44% compared to 23%). These disparities are similarly pronounced for depression during pregnancy (Gavin et al., 2011), although prenatal depression is studied less often than postpartum depression. These public health trends highlight that this dissertation's target population is at particular risk. Latina women also experience barriers to accessing prenatal care, health insurance, and maternal mental health services compared to their White counterparts, exacerbating the risk of psychological distress and adverse health outcomes for both mothers and infants (Rivers & Patino, 2006; Torres et al., 2012; Town et al., 2024).

2.3.3 Public Health Trends and Resilience

Many scholars have written about a 'Latino Health Paradox', noting positive health trends among Latinos, such as lower mortality risk, compared to their White peers (Brown et al., 2007;

Cervantes et al., 1999; Cho et al., 2004; Lara et al., 2006). This health pattern leads some scholars to suggest that the focus of future research should be on the role resilience factors play in these health trends (Bender & Castro, 2000; Ruiz et al., 2013). For this reason, this dissertation includes measurements of family social support alongside stress and stressors (Aims 2 and 3). However, the 'Latino Health Paradox' is only found for a handful of outcomes like risk of premature mortality and asthma (Ruiz et al., 2013; Taningco, 2007). Latinos tend to experience worse outcomes than White peers in terms of obesity, diabetes, and psychological distress (Taningco, 2007).

2.3.4 Public Health Trends and Adverse Birth Outcomes Among Latinos

There are conflicting aspects of the Latino Health Paradox with regard to birth outcomes. A systematic review and meta-analysis of adverse birth outcomes among ethnic minorities in the U.S. found no significant difference of odds-ratio of Hispanic/Latino birthing people compared to White birthing people (Schaaf et al., 2013). However, of the eleven studies included in this meta-analysis "six reported on 'Hispanics' without defining the group in more detail" (Schaaf et al., 2013, p. 439). A cohort study that aggregated all in-hospital live births from January 1, 2009, through December 31, 2018 (representing over 34 million singleton live births in U.S. hospitals) found significant variation in attributes like maternal race/ethnicity and nativity (Barreto et al., 2024). Specifically, Barreto et al. (2024) found that while Latino (reported as Hispanic) preterm births were not significantly different than White preterm births after being adjusted for relevant covariates, Latino birthing people were significantly more likely to have extremely-preterm births (<29 weeks' gestation) than White birthing people. Preterm birth is categorized as late (34-36 gestational weeks), moderately (29-34 gestational weeks), and extremely (<29 gestational weeks) preterm. Additionally, the same study found that all U.S.-born groups were significantly more

likely to be preterm than their foreign-born counterparts (Barreto et al., 2024). Thus, a nativity advantage as well as differences in *types* of preterm birth may have overshadowed the disparities in birth outcomes among minorities in previous reports.

The CDC's National Vital Statistics report of 2020 describes that Latino birthing people have higher rates of preterm birth (PTB) and low birth weight (LBW), 9.8% and 7.4% respectively, than White birthing people, 9.1% and 6.8% (Driscoll & Gregory, 2021). While these disparities in adverse birth outcomes are smaller than the disparities experienced by Black birthing people (14.4% and 14.2%), the Latino-White disparity also deserves addressing. The adverse birth outcomes and associated morbidity risks have a large consequence on the health of the American population considering Latinos have the highest birth rates in the U.S. (March of Dimes, 2024). It is important to note that while all groups have experienced a decline in fertility rates in the last two decades, Latinos have experienced the greatest decline and yet sustain the highest fertility rates of any group (Kroeger et al., 2023).

2.3.5 Health Patterns Among Latinos Considering Nativity/Generational Status

Another version of the Latino Health Paradox describes the unexpected trend of U.S.-born Latinos (i.e., second-generation) having poorer health outcomes compared to foreign-born Latinos (i.e., first-generation) (Cervantes et al., 1999). For example, rates of maternal depression are impacted by nativity: U.S.-born Latina women experience substantially higher depression (44%) compared to foreign-born Latina women (34%) (Huang et al., 2007). Additionally, adverse birth outcomes, like preterm birth and low birth weight, are more likely to occur among U.S.-born Latinos than foreign-born Latinos, above the effect of sociodemographic characteristics (Adegoke et al., 2022; Barreto et al., 2024). This trend is unexpected in that children of immigrants likely

have more socio-economic advantages, including higher income and educational levels, than their parents.

The trend of a general immigrant health paradox is more robust than an overall Latino health paradox. Although there are similarly conflicting results based on the definitions of both immigrant and domestic-born reference groups (i.e., whether the category of foreign-born includes refugees and whether domestic-born includes 3rd generation and beyond) (Elshahat et al., 2022). Several reviews of the last 50-years of perinatal health research have found substantial evidence of nativity predicting risk for adverse birth outcomes, with U.S.-born birthing people having worse outcomes than their foreign-born counterparts (Montoya-Williams et al., 2022; Barreto et al., 2024).

2.3.6 Discrimination and Acculturation as Contributors to Health Patterns Among Latinos

These nativity findings potentially proxy differences in the experience of discrimination and acculturative stress. When split by generational status, 25% of 1st generation/foreign-born Latinos reported experiencing everyday discrimination compared to 43% of 2nd generation/U.S.-born Latinos, and 50.4% of 3rd generation/U.S.-born Latinos (Pérez et al., 2008). Highly-acculturated <u>foreign-born Latinos</u> were **more likely** to experience discrimination than less-acculturated foreign-born Latinos (Finch et al., 2000). In contrast, highly acculturated <u>U.S.-born Latinos</u> were **less likely** to experience discrimination than less acculturated U.S.-born Latinos (Finch et al., 2000). Together, these results suggest that individuals are more likely to experience discrimination (a toxic stressor) when they feel greater levels of bicultural identity and/or acculturative stress. This is further supported by Cervantes et al. (2013) who find that of all Latinos (1st, 2nd, and 3rd generation) who reported similar rates of discrimination, 2nd generation individuals experience more acculturation stressors compared to 1st or 3rd generation Latino individuals.

While not all U.S.-born individuals are children of immigrants nor all children of immigrants U.S-born, both foreign-born and U.S-born children of immigrants encounter a range of distinct stressors that significantly impact their overall stress levels (Mendoza et al., 2017; Romero & Roberts, 2003). Health research that frames nativity disparities as a 'paradox' overlooks the unique challenges faced by the 1.5 and 2nd generation (explored in Aim 3). For example, acculturation away from family values can lead to feelings of alienation (Suarez et al., 1997). Additionally, both U.S.-born and foreign-born children of Mexican immigrants reported experiencing distinct stress from intergenerational acculturation gaps between family and self, within-group discrimination, out-group discrimination, and monolingual stress (i.e., feeling dissatisfied with their English or Spanish language skills) (Romero & Roberts, 2003).

2.3.7 Intergenerational Considerations of Latino Health Disparities

The disparities in psychological distress and birth outcomes based on nativity can also be understood by comparing parents (foreign-born/1st generation) and their offspring (U.S.-born/2nd generation). Therefore, an intergenerational transmission of health risk should be considered. Disparities in both mental health and birth outcomes broadly motivate this dissertation in order to understand how stressors and stress become embodied. It remains unknown whether the deleterious health consequences of socio-cultural stressors are biologically transmitted from one generation to the next. However, epidemiological trends between generations justify the possibility of intergenerational transmission, with pregnancy representing an especially vulnerable window (Fox et al., 2015, 2018), This is explored in Aim 1.

Additionally, exposure to stressors may be purely socio-economic or even cultural. For example, the challenges of immigrant life in the U.S. (such as limited income, access to healthcare, and housing options) can shape the developmental environment of the children of immigrants (Kim

et al., 2018; Perreira & Ornelas, 2011; Pumariega et al., 2005). A study of Mexican-born mothers in focus groups identified four themes that indicate how maternal stressors can impact children's health, including transmission of anxiety and fears to children (Non et al., 2019). In Aim 3, I explore this intergenerational transmission of stress among 1.5 and 2nd generation women who describe tension between their parents' Mexican identity and their broader Mexican-American identity.

I also consider resilience from an intergenerational perspective. In Aims 2 and 3, I focus specifically on grandmothers as sources of various forms of social support to and stress-buffering of mothers. Latinos, as the largest immigrating minority in the U.S., have simultaneously the highest rates of cross-border families (PEW Research Center, 2020) and the highest rates of three-generation homes (i.e., grandparents and grandchildren who live together) (Cohn & Passel, 2018; PEW Research Center, 2010) compared to other ethnic groups. High rates of both cross-border families and shared intergenerational homes creates the opportunity to explore the effect of variation in social support from, communication with, and geographic proximity to family. This dissertation offers greater insights into the growing disparities in obstetric outcomes and the potential intergenerational cascade of disease risk by exploring mental health, social support, and pregnancy biology together.

3. Study Design

The National Institute on Minority Health Disparities (NIMHD) suggests the use of multidimensional research frameworks to comprehensively study the complex problems of minority health disparities (National Institute on Minority Health Disparities, 2017). By simultaneously considering levels (e.g., individual, interpersonal, community) and domains (e.g., behavioral or environmental) of influence, researchers and policymakers can capture the complex

interactions that create health disparities and consider possible points of intervention. In this dissertation, I focus on the individual and interpersonal levels of influence (Table 1.1), in which pregnant women are the individuals and their interpersonal networks include the biological connections through the placenta to their developing children and the people from whom they receive discrimination or social support. I also focus on biological (specifically, prenatal psychological distress and placental stress) and sociocultural domains of influence. The sociocultural domain includes the individual's cultural identity and how this intersects with the cultural identity/identities of her larger social network.

Table 1.1: Research Framework of Domains and Influence Levels Evaluated

		Levels of Influence	
Domains		Individual	Interpersonal
of	Biological	Psychological distress	Placental stress
Influence	Sociocultural	Socio-demographics & Cultural Identity	Ethnic Discrimination & Social Support

3.1 Study Population and Data Samples

This dissertation focuses on the experiences of almost 300 perinatal Latina women living in Southern California using data from three research projects: the Mothers' Cultural Experiences Project Waves 1 and 2 and the Supporting Mothers Project (Figure 1.3). These projects will be described in the order in which they were established and recruited women to participate, and not the order in which they appear in the dissertation.

Figure 1.3: Data Sources Used in Dissertation
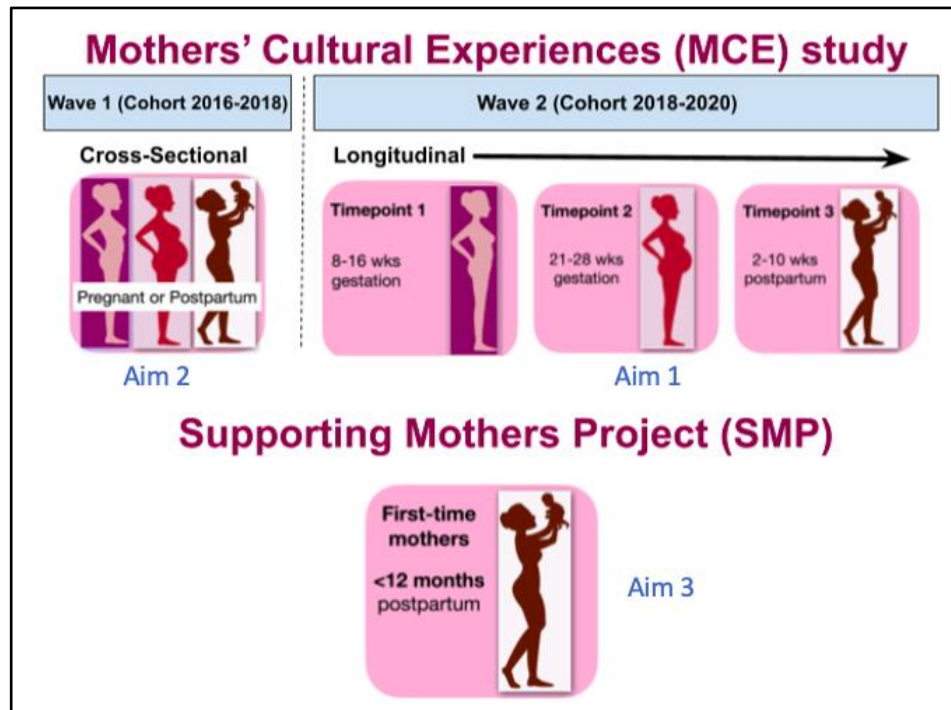
Figure 1.3 Caption: I make use of three data sources within this dissertation, which all together represent almost 300 perinatal Latina women living in Southern California, who gave birth between 2016-2020.

The first project that this dissertation draws upon is Wave 1 of the Mothers' Cultural Experiences (MCE) project. The overarching study goals of the MCE project are to investigate the various social, cultural, and environmental stressors on maternal psychology and fetal/infant development. Wave 1 involves 361 perinatal women who were recruited from clinic waiting rooms or breastfeeding classes across four sites in Southern California between the years 2016-2018. Participants were given the option to complete an anonymous survey in either English or Spanish. Ethical approval for this study was obtained from the Institutional Review Boards of all participating institutions (UC Irvine IRB #2015-1947, UCLA IRB #16-001423, Olive View Approval #1086735-1; County of Orange Health Care Agency Approval #2015-03), with appropriate reliances in place.

Wave 2 of the MCE project similarly focused on women residing in Southern California who identify as Latina, and speak English or Spanish. The study goals were the same as MCE Wave 1. In addition to survey questions of identity and acculturation, new survey questions surrounding topics like immigration experiences were added. Additionally, the collection of biological samples (blood, urine, and saliva) at two prenatal timepoints continued Wave 1's research questions into the biological realm. MCE Wave 2 recruited 107 women that were <16 weeks' gestational age in their pregnancy during December 2018 to March 2020, with two prenatal timepoints with surveys and biological samples and two postnatal follow-ups with surveys. Chapter 2 makes use of this data, but from a subset of women (N=55) who consented to participate in a sub-study on genetics and placental cells/parts of cells. This study was approved by UCLA IRB #18-000434. Study participants were recruited at three obstetrics clinics serving primarily low-income Latino populations: Olive View-UCLA Medical Center in Sylmar, CA, UCLA West Medical in Los Angeles CA, and Venice Family Clinic in Santa Monica, CA.

The Supporting Mothers Project shared many of the same recruitment and overall study goals in terms of understanding acculturation and immigration experiences and how these relate to minority health disparities in psychological distress. However, this project makes use of qualitative methods in order to provide thick descriptions of these women's lives. Additionally, recruitment inclusion was limited to women who were children of immigrants or who immigrated before the age of 12. This resulted in a unique, but shared, experience of biculturalism as individuals often negotiated between the diametrically opposing cultural influence of their family and heritage culture versus the culture of their peers and place of residency.

3.2 Methods

Given that each chapter uses different methodologies, brief summaries of each will be provided in the next section rather than a description of an overarching methodology. By using a combination of qualitative and quantitative methods, I offset the limitations of a single-method approach. Through biological laboratory methods, I study the placenta directly *in-vivo* during early gestation in order to uncover potential mechanisms of stress embodiment. Through use of quantitative surveys, I examine patterns of stress and interpersonal relationships with a higher reliability due to the larger cohort of individuals. Finally, through qualitative interviewing with a smaller cohort of women, I explore the experiences of stress, culture, family and social support with richer depth. In qualitative research, we minimize assumptions as women can share directly how they feel in response to certain aspects of society, culture, and families. Qualitative and ethnographic research are at the heart of anthropology, but evolutionary biology and public health are newer to using these methods. By privileging the perspectives of women and elevating their stories as part of the research program, we can ensure a more respectful line of research that is greater than the sum of its parts.

3.3 Aims and Chapter Overviews

In this dissertation, I use three distinct methods to ask how psychosocial stressors, stress, and resilience systems during pregnancy influence mental health outcomes among Latina women living in Southern California. This interdisciplinary approach uncovers aspects of both the biological and sociocultural domains at the individual and interpersonal level during the perinatal period that impact maternal health (Table 1.1). Aim 1 investigates a novel placental biomarker as a potential mechanism for stress embodiment during pregnancy (Figure 1.1). Aim 2 considers resilience from an intergenerational lens, focusing on grandmothers' roles in providing social support and buffering stress (Figures 1.1 and 1.2). Finally, Aim 3 explores the unique stressors and

social support mobilization among first-time Mexican-American mothers who are a part of the critical 1.5 and 2nd generation. I will discuss how the chapters here-in answer the research questions posed within each aim.

It is critical to study the placenta directly to understand how stress may be impacting birth outcomes. However, given the vulnerable nature of pregnancy, it is difficult to acquire such data without highly-invasive methodologies. **Chapter 2** traces the relationship between maternal psychological distress and placental activity using state-of-the-art nanomolecular immuno-affinity assays. With these innovative biomolecular methods, I investigate placental extracellular vesicles (pEVs), crucial in feto-maternal communication, to explore the interplay between psychological distress and placental biology. pEVs are small membrane-bound structures released by trophoblasts cells into the maternal bloodstream (Doyle & Wang, 2019). Extracellular vesicles (EVs) play an important role in intercellular communication by transferring various molecules such as proteins, nucleic acids (like RNA and DNA), and lipids between cells (Tong & Chamley, 2015). pEVs act as conduits for information exchange between the mother and the developing fetus. By releasing pEVs into the maternal bloodstream, the placenta enables bidirectional communication (Tong & Chamley, 2015). Using plasma samples of N=41 women from MCE Wave 2 timepoints 1 and 2, I demonstrate that increased psychological distress during pregnancy - a known risk factor for adverse birth outcomes - relates to a decrease in human leukocyte antigen (HLA)-G+ placental EVs across pregnancy. Shifts in pEV quantity may signal changes in placental function and/or fetal well-being. In Chapter 2, I find a reduction in the release of HLA-G+ EVs in response to maternal psychological distress. This suggests a potential disruption in the communication between the developing fetus and the maternal immune system. By exploring how

placental cells respond to stress across pregnancy, this dissertation makes a contribution towards uncovering the biological mechanism of stress embodiment.

In **Chapter 3**, I explore resilience against stress embodiment and consider how evolution shapes human social relationships during pregnancy. Given the negative consequences of stress on birth outcomes, I posit that allomothers should be adaptively motivated to improve the psychological distress of pregnant women. To test this idea, I assess several relationship factors between soon-to-be mothers and grandmothers using data from 216 pregnant women who participated in Wave 1 of MCE. I find that communication and emotional support from maternal grandmothers is associated with significantly lower levels of maternal depression. Given the association between prenatal depression and offspring morbidity throughout life, this may reflect an adaptive strategy that improves grandmaternal inclusive fitness.

I extend the research questions of Chapter 3 into **Chapter 4** by exploring if these prenatal grandmaternal effects are explicitly stress *buffering*. With the same MCE Wave 1 cohort of 216 pregnant women, I evaluate if any of these relationship factors moderate the negative association of discrimination on mental health. First, I replicate the finding in the literature that discrimination is associated with worsened maternal mental health. Specifically, I find discrimination to be significantly, positively associated with depression, anxiety, and stress in linear regression models. Next, I show that communication and emotional support from maternal grandmothers moderates the psychological distress experienced by pregnant women. This chapter highlights an important avenue of resilience during pregnancy against psychosocial stressors like discrimination. Together chapter 3 and 4 utilize quantitative methods (with validated scales in self-report questionnaires and multiple-linear regression models) to build a case for the existence of a prenatal allomaternal effect.

Finally, **Chapter 5** explores the lived experiences of Mexican-American women who are adult children of immigrants and first-time mothers. Through semi-structured, person-centered interviews and systematic content analysis for themes, this chapter assesses (1) bicultural stress, (2) intergenerational experiences of care, and (3) the underutilization of social support and stigma against asking for help among Latina women. This research includes members of the 1.5 generation and explores the cultural milieu surrounding social support; both crucial, but understudied, issues in postnatal research. In contrast to the idea presented in the literature that women do not ask for help due to concerns of appearing that they cannot handle motherhood, I find women to not ask for help when they do not want to overburden their family members. Thus, not asking for help can be reframed as an act of care for their families, and not something easily targeted by intervention. I propose that policy should prioritize structural reforms and concrete resources over programs that solely target initiatives and/or education aimed at individuals.

Overall, these chapters together seek to build a richer description of maternal psychological distress, embodiment, and resilience during the perinatal period among Latina mothers. This dissertation contributes to the understanding of minority health disparities and considers what might improve maternal-fetal outcomes in the future.

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Chapter 2: A Novel Biomarker of Placental Communication in Association with Prenatal Maternal Psychological Distress

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Abstract

Maternal prenatal psychological distress alters fetal development leading to adverse birth outcomes. However, researchers have yet to fully understand the biological mechanism behind

these patterns. In order to elucidate how the placenta responds to maternal psychological distress, we investigate the relationship of psychological distress with placental extracellular vesicles (pEVs). The recently uncovered role of pEVs in cell-to-cell and feto-maternal communication affords us the opportunity to evaluate the activity of placenta cells *in vivo* at the maternal-fetal interface. Here, we employ novel methods to track pEVs across pregnancy in a cohort of N=41 pregnant Latina women. We measure prenatal anxiety and depression using self-report psychometric questionnaires and quantify pEVs using immunoaffinity capture with human leukocyte antigen (HLA)-G at two timepoints in early-gestation μ=12.4 weeks (SD=2.7) and later-gestation μ=25.2 weeks (SD=3.0). Using multiple linear regression models, we find both maternal anxiety (*ß*= -0.13; robust SE = 0.06; p-value = 0.043) and depression (*ß*= -0.11; robust SE = 0.05; p-value = 0.023) in early-gestation relate to fewer pEVs in later-gestation. The association of anxiety and depression with lower pEVs suggests that maternal psychological distress may dampen placental signaling. This chapter uncovers part of a potential biological mechanism of stress embodiment in order to explain the wider trends between maternal stress and adverse birth outcomes.

1. Introduction

Maternal prenatal depression, anxiety, and stress (known together as psychological distress) are commonly experienced in pregnancy (Fishell, 2010). While not all pregnant people identify as women or become mothers, we use the terms 'women' and 'maternal' to maintain clarity between maternal and fetal biological systems. It has been robustly shown epidemiologically that adverse birth outcomes (i.e., low birth-weight, preterm birth, and intrauterine growth restriction) are more likely when pregnant women experience stressors and, concomitantly, psychological distress (Carty et al., 2011; Collins et al., 2004; Dunkel Schetter &

Tanner, 2012; Grigoriadis et al., 2013, 2018; Grote et al., 2010; March of Dimes, 2015). Within these trends, the placenta is assumed to transmit psychological stress-related biological markers to the fetal compartment (Entringer et al., 2015), yet, this pathway remains unresolved. Prenatal psychological distress may exert an influence on fetal development through endocrine, inflammatory, metabolic, and/or oxidative stress pathways, which all implicate the involvement of the placenta (Musillo et al., 2022). The placenta is a transient organ that develops during gestation, acting as the point of exchange between fetus and mother, and exits the mother after birth. This organ becomes the connection point for all biological communication between the maternal and fetal compartments. More placental research is needed; however, studying the placenta during gestation and *in vivo* is difficult. Current common and minimally-invasive ways to study the placenta include: (1) *ex-vivo* examination of the organ post-parturition, and (2) through placental biomarkers, namely analytes such as placental corticotrophin-releasing hormone (pCRH) and the enzyme 11β-HSD2, during gestation. Here, we work towards elucidating the biological mechanism by which maternal psychological distress may contribute to downstream adverse health consequences for the offspring by examining how distress relates to a novel biomarker of placental perturbation (Figure 2.1).

Figure 2.1: Study Summary
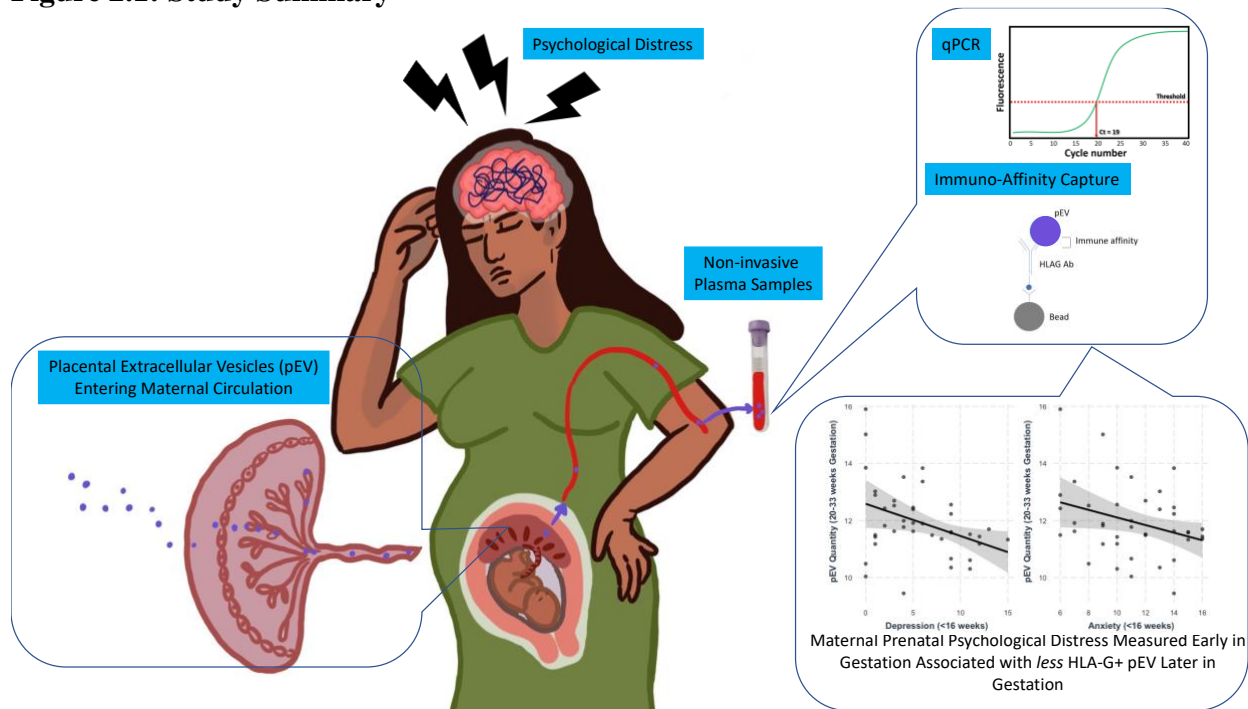
Figure 2.1 caption: We study the relationship between psychological distress and placental extracellular vesicle (pEV) quantity using minimally invasive plasma samples from 41 pregnant Latina women. Through anti-human leukocyte antigen G (HLA-G+) immunocapture techniques and qPCR technology, we determine that maternal prenatal anxiety and depression measured early in gestation was significantly associated with less HLA-G+ pEV quantity later in gestation.

We measure extracellular vesicles (EVs) as a novel biomarker. EVs are released by various tissues and cell types in the human body and facilitate cell-to-cell communication by transporting biomolecular cargo (such as proteins, lipids, mRNA, and miRNA) from the originating cell to target cells (Bai et al., 2021; Doyle & Wang, 2019). In cancer research, extensive studies have shown that tumor EVs promote metastasis by enhancing cell migration, invasion, and immunomodulation within the tumor microenvironment (Qin et al., 2021). Similarly, placental EVs (pEVs) enhance placental activity and are integral to feto-maternal cellular communication. Investigating pEVs provides a minimally invasive approach to assess placental function during pregnancy *in vivo*. Notably, multiple pathways—including inflammation, metabolic and endocrine

functions, and oxidative stress—can influence both the quantity and cargo of pEVs. Therefore, pEVs offer a valuable overarching physiological measurement of the feto-placental unit.

Various justifications support our selection of pEVs as a biomarker of placental stress. For instance, placental inflammation has been linked to variations in pEV release and bioactivity (Nakahara et al., 2020). Similarly, post-traumatic stress-disorder, anxiety, and depression have all been connected to peripheral/systemic inflammation (Rohleder, 2014; Speer et al., 2018), suggesting a possible connection between psychological distress and pEVs through inflammation. pEVs may also represent a "biomolecular fingerprint of the progression of pregnancy" (Menon et al., 2019). Indeed, an inflammatory profile discovered through proteomic analysis of PLAP+ pEV cargo early in the first trimester was associated with very to moderate preterm birth (PTB) (Menon et al., 2020). Further supporting the biological possibility of our proposed model: studies have shown that pregnancy complications, such as preeclampsia (Salomon et al., 2017) and gestational diabetes (GD) (Salomon et al., 2016), are associated with increased EV quantity and altered cargo compared to pregnancies without complications, as measured in total EVs and placental alkaline phosphatase (PLAP+) pEVs circulating in maternal plasma. PTB and to an extent preeclampsia and GD are obstetric complications that have been associated with higher levels of psychological distress (Dole, 2003; Grigoriadis et al., 2013, 2018; Grote et al., 2010; Hinkle et al., 2016; Kurki et al., 2000; Qiu et al., 2007). Additionally, a recent study explored the relationship of depression, perceived stress, and prenatal distress with miRNA profiles extracted from *non-specific* circulating EVs derived from plasma samples, suggesting a potential relationship of psychological distress and altered EV cargo during pregnancy (Foley et al., 2023). While the aforementioned pregnancy complications have been connected to psychological distress and pEVs quantity/cargo independently, no work yet has directly investigated how psychological distress relates to pEVs.

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EVs captured through various collection methods and positive for PLAP+ are detectable as early as 6 weeks gestational age, increase monotonically across pregnancy, and drop off within 24-hours after parturition (Adam et al., 2017; Sarker et al., 2014). While concentrations of PLAP+ pEVs (referred to as 'microparticles' by Orozco et al.) have been shown to be highest during the second and third trimesters, concentrations of EVs positive for human leukocyte antigen (HLA)-G were highest in the first trimester (Orozco et al., 2009). HLA-G+ pEVs are expressed by extravillous trophoblasts, which is the cell-type that invades maternal tissues early in gestation. In this study, we utilize novel immunoaffinity technology with HLA-G+ antibodies to capture and quantify pEVs. We focus on quantity to establish a baseline of how pEVs change during pregnancy and in response to psychological distress. We choose to focus on HLA-G+ pEVs as its a more biologically-relevant marker for our research question than PLAP+ pEVs, given previous associations between markers of stress and extravillous trophoblasts. Specifically, psychological distress is associated with activation of the hypothalamic-pituitary-adrenal (HPA) axis, including control of the release of glucocorticoids like cortisol, which modulate inflammation and the physiological stress-response (Herman et al., 2016). Administration of glucocorticoids to immortalized human first-trimester extravillous trophoblast cell lines results in impaired extravillous trophoblast function (including alterations to migration, invasion, and proliferation) (Húngaro et al., 2021; Kisanga et al., 2018; Smith et al., 2017). Thus, we hypothesize that experiencing stressors during pregnancy activates the HPA-axis stress response, likely altering extravillous trophoblast function *in vivo* in addition to the quantity and cargo of pEVs.

Early gestation represents a particularly vulnerable period for fetal development. Here, we examine the biological implications of psychological distress in early gestation. This focus on early pregnancy stems from evidence suggesting that psychological distress during the early stages of

gestation is more likely to impact placental development and, consequently, influence birth outcomes compared to distress experienced later in gestation (Entringer et al., 2015). Research consistently shows that exposures early in gestation, such as the Dutch Hunger Winter during World War II and the discrimination experienced by Arab American women in the U.S. following the 9/11 attacks (Brown, 2020; Lauderdale, 2006; Roseboom et al., 2006), have more pronounced effects on birth outcomes compared to individuals experiencing those exposures later in gestation. Additionally, women become less physiologically responsive to psychological stress as pregnancy advances (Glynn et al., 2001, 2008). Experimental work suggests that psychological stress may have a more pronounced biological signature early in gestation compared to later. For example, the acute stress response of pregnant and non-pregnant women was assessed with the Trier Social Stress Test (TSST) 14 weeks apart (i.e., 17 and 31 weeks' gestation in the pregnancy group) (Entringer et al., 2009). TSST elicited significant changes in both groups (including heart rate, blood pressure, and psychological distress), but physiological stress responses were significantly attenuated later in gestation (and no decrease in the control group suggesting it was not attributable to habituation to the stressor) (Entringer et al., 2009). Given this evidence, we designed our models to measure the effects of psychological distress in early gestation.

We aim to determine if there is an association between psychological distress and quantity of placental EVs. We approach this research question in two ways. The first is a set of models comparing early gestation psychological distress with pEV quantity concurrently and at a later timepoint. The second approach uses a measurement of change in pEV quantity over time. The change in pEV measure captures the trajectory of pEVs across placental development.

2. Methods

2.1 Cohort

This research uses data from Wave 2 of the Mothers' Cultural Experiences (MCE) project, an NIH-funded study of pregnant Latina women in Southern California. The overarching goal of the MCE project is to advance the understanding of the connection between socio-cultural stressors and maternal-fetal health and postnatal infant development. Wave 2 is a prospective, longitudinal study that followed women recruited during early pregnancy through 18-months postpartum. Eligibility for MCE Wave 2 included women who were age 18 years or older, English or Spanish speaking, and self-identified as Latina, Hispanic, Chicana, Mexican, or Latin American. Participants were recruited in prenatal clinic waiting rooms between 2018-2020 and received modest monetary compensation. The two prenatal assessments included a self-report questionnaire and samples of blood, urine, and saliva. Materials were available in English and Spanish. Participants provided written, informed consent. Human subjects' ethics approval was received from the institutional review boards of participating institutions (UCLA IRB#18-000434; Olive View-UCLA Education & Research Institute IRB# 1086735; UC Irvine IRB#16-001423). All methods for this study were performed in accordance with the relevant guidelines and regulations of all participating institutional review boards with the appropriate reliances. Procedures comply with the tenets of the Declaration of Helsinki.

Of the total 107 women recruited into MCE's Wave 2, 55 women opted-in to a sub-study, through additional consent, on genetic material, placental cells, and parts of placental cells. We only include the 42 women with singleton pregnancies who completed both the first and second time-points with enough plasma material for analysis (Appendix A, Figure S2). One woman was dropped from analysis due to her plasma sample being collected outside of the stated gestation window due to a scheduling error of her follow-up visit. All models were run on the final analytic cohort, N=41.

Maternal and fetal health is worsening in the U.S. (Hill et al., 2022), but there are particularly growing challenges for Latina women (Lopez et al., 2018; Ramos et al., 2010). While race/ethnic categories are social and not biological, social factors tied to race/ethnicity can influence biology (Gravlee, 2009). For example, psychological distress can become embodied or 'get under the skin', which contributes to health disparities between minority and majority ethnic groups (Gravlee, 2009). Latina women face unique socio-economic stressors, with greater levels of food insecurity, discrimination, and poverty than their non-Latina White counterparts (Curci et al., 2022; Office of Minority Health Resource Center, 2021; Rodriguez et al., 2021; U.S. Census Bureau, 2021). Latina women face greater obstetric issues compared to non-Latina White peers, including higher rates of perinatal depression, postpartum hemorrhage, low birth weight, preterm birth, and inadequate prenatal care (Earnshaw et al., 2013; Fryer et al., 2020; Office of Minority Health Resource Center, 2021; Osterman et al., 2023; Public Policy Institute of California, 2020). Additionally, Latinos are the most uninsured demographic group in California (Becker et al., 2019). Given these group-specific issues connected to minority health disparities, we ask these research questions in a diverse Latina cohort.

2.2 Protocol for Collection of Plasma Samples

The timing of the two prenatal assessments were chosen to occur approximately during the transition from first to second trimester (timepoint 1, μ=12.4 weeks' gestation, range 5-17 weeks) and second to third trimester (timepoint 2, μ= 25 weeks' gestation, range 20-33 weeks' gestation). At each timepoint, participants donated a blood sample by antecubital venipuncture by clinic phlebotomists into two 10 mL vacutainers coated with anticoagulant ethylendiaminetetraactic acid (EDTA). Samples were kept in a cooler at refrigerator temperature and transported immediately to the Biological Anthropology of Motherhood Laboratory at UCLA, arriving within a few hours of

the blood draw. Whole blood was transferred into 15 mL Falcon tubes and centrifuged at 1500 rpm for 10 minutes at 4°C. Plasma was then isolated and aliquoted into 2.0 mL cryogenic storage vials and stored at -80°C until pEV isolation.

2.3 Isolation and Quantification of Placental Extracellular Vesicles

Placental EVs were isolated and quantified using the standardized quantification assay for subpopulations of EVs developed by the UCLA Liquid Biopsy Lab. Banked plasma samples stored at -80°C were quickly thawed and centrifuged at 10,000g for 10 minutes at 4°C to remove the precipitates. On average, samples had undergone 1 previous freeze-thaw cycle, although a range of 0-2 previous cycles were used for this study.

Placental EVs were labeled with anti-HLA-G in plasma. 100µL of spun plasma was diluted at 1:1 ratio using TE buffer and incubated with an optimized amount of HLA-G antibody for 45 minutes at 40-50rpm before further incubated with BSA-blocked beads for 45 minutes. The sample was then centrifuged to remove supernatant, then rinsed with washing buffer. After washing three times, the supernatant was discarded, and the precipitate was suspended with lysis buffer for 10 minutes. We prepared the one-step RT-PCR reaction mixture, with PCR mix, primer-probe mix, sample lysate, and RNase Free Water. Real-time PCR reactions were set for 45 cycles. Placental EVs were quantified for statistical analysis by subtracting the Ct-value from 45. Ct-value is the number of amplification cycles undergone by the sample before crossing above a consistently set fluorescent threshold value of 25. The more cycles needed to rise above this set threshold, the less Actin is fluoresced, which suggests less pEVs present in the sample.

We limited the protocol to four participants at a time to minimize operator error. Each batch thus included eight samples: two prenatal timepoints for four unique participants. See supplemental section in Appendix A.4.3 for more interrogation of potential batch and operator

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effects. Patient-timepoint matched samples were always run on the same day by the same operator. By using a change over time measurement in our second statistical model, we are able to account for within-individual variation.

We also conducted a titration experiment to validate the methods of placental EV quantification assay. We find a strong linear relationship between plasma volume used and HLA-G+ pEV quantification (Appendix A, Figure S1).

2.4 Maternal Psychological Distress Assessments

At each prenatal assessment, participants completed a questionnaire, which included self-report demographic, health, and personal history questions as well as various validated psychometric scales. For example, there were assessments in the survey of perinatal depression, state anxiety, loneliness, pregnancy-related anxiety, and perceived stress. Given that most evidence for the association of psychological distress with adverse birth outcomes has been demonstrated in meta-analyses for anxiety and depression (Ding et al., 2014; Grigoriadis et al., 2013, 2018; Staneva et al., 2015), we explore only anxiety and depression in this chapter.

We assessed participant depression levels by using the Edinburgh Perinatal Depression Scale (EPDS) (Cox et al., 1987; Garcia-Esteve et al., 2003; Murray & Cox, 1990). We did not include the self-harm item, as other studies have also omitted, given ethical concerns of causing more harm without resources to protect the women participating in the study. This 9-item EPDS has been shown to highly correlate with the original 10-item EPDS scale, with strong sensitivity (Qiu et al., 2023; Appendix A.1). To determine the participants' EPDS score, a sum is taken (with a possible range of 0-27 for the 9-item scale). A clinical depression cut-off score of 10/11 has been suggested for individuals completing the 10-item EPDS translated into Spanish (Appendix A.2). We only use this cut-off in the cohort demographic table (Table 2.1), and since we do not adjust

this cut-off for the 9-item reduced scale, our estimates of participants experiencing clinical depression is conservative (Appendix A.2). We assessed if there was acceptable reliability within our cohort by calculating the Cronbach alpha (*a*). We also present *a* by language (*a*E for English-questionnaire and *a*S for Spanish-questionnaire). The reliability of EPDS in our cohort is $a = 0.85$ (*a*E = 0.84, *a*S = 0.87).

For state anxiety, we used the Spielberger State-Trait Anxiety Inventory-Short Form (STAI-SF) (Marteau & Bekker, 1992), which is commonly used in pregnancy research (Meades & Ayers, 2011). The STAI-SF scores participant anxiety with a sum of items, which can range from 6-24. For how we arrived at the cut-off score presented in Table 2.1, see Appendix A.2. In our cohort, the reliability of the STAI-SF scale is $a = 0.64$ (*a*E = 0.68, *a*S = 0.61).

2.5 Statistical Methods and Data Analysis

We use multiple linear regression models to assess the relationship of early gestation psychological distress and pEV quantity, while controlling for gestational age:

Model 1a: $Y_{pEV\ quantity\ at\ Timepoint\ 1} = B_0 + B_1\ {}_{Psychological\ Distress} + B_i\ {}_{Gestational\ Age}$

Model 1b: $Y_{pEV\ quantity\ at\ Timepoint\ 2} = B_0 + B_1\ {}_{Psychological\ Distress} + B_i\ {}_{Gestational\ Age}$

Model 2: $Y_{Change\ in\ pEV\ quantity} = B_0 + B_1\ {}_{Psychological\ Distress} + B_i\ {}_{Gestational\ Age}$

The psychological distress variables are evaluated in independent models (i.e., one sub-model for depression and one sub-model for anxiety within each named model above), since we are interested in the unique effects of each distress measure. Gestational age is included as a control variable, given the literature suggesting that pEVs change across pregnancy. For Model 1a, we use gestational age at timepoint 1 as the only control variable. For Model 1b, gestational ages at timepoint 1 and 2 are included. For Model 2, gestational age at timepoint 1 and the change in gestational age (in weeks) between timepoints are used.

Our outcome variable measures the quantity of HLA-G+ pEVs in 100µL of maternal plasma (Model 1). We also use change in pEV quantity between timepoints (Model 2), which was calculated as $2^{(45\text{-Ct-value of Timepoint 2 Samples}\ -\ 45\ \text{-Ct-value of Timepoint 1 Samples})}$.

3. Results

3.1 Cohort

The analytic cohort for this study included 41 women with an average age of 31 (SD=5.47) years; 19 of whom were born in the U.S., 14 in Mexico, and 8 in other Latin American countries (Table 2.1). Most women (N=35, 82.9%) completed their high school education, with the remaining women (N=7, 17.1%) completing less than high school. Many women in our sample were in a relationship (N=37, 90.2%) and already had children (N=25, 61.0%). Additionally, some women were smokers before their pregnancy (N=8, 19.5%). Latinos disproportionately experience food insecurity in the U.S. (16-22% compared to the national average of 11-14%) (Rodriguez et al., 2021); we find this replicated in our cohort where 7 of the 41 women (17.1%) were experiencing food insecurity. Using an EPDS cutoff score of 10, 7 women (17.1%) had a high likelihood of clinical depression. There are no significant differences in demographic or health history characteristics between the depressed and non-depressed cohort subsets (Appendix A, Table S3) and no statistically significant differences between the characteristics of anxious and non-anxious women (Appendix A, Table S4).

Table 2.1 Cohort Characteristics

	Overall (N=41)		Overall (N=41)
Age (years)		**Range of Depression scores (EPDS)**	
Mean (SD)	30.7 (5.47)	Mean (SD)	5.51 (4.21)
Country of Origin		**Anxiety**	

	Overall (N=41)		Overall (N=41)
U.S.	19 (46.3%)	Anxious	15 (36.6%)
Mexico	14 (34.1%)	Not Anxious	26 (63.4%)
Other Latin American Country	8 (19.5%)	**Range of Anxiety scores (STAI-SF)**	
Education		Mean (SD)	11.1 (3.08)
Less than High School	7 (17.1%)	**HLA-G+ pEV at Timepoint 1 (per 100 μL of plasma)**	
High School or Equivalent	34 (82.9%)	Mean (SD)	12.7 (1.24)
More than High School	0 (0%)	**HLA-G+ pEV at Timepoint 2 (per 100 μL of plasma)**	
Relationship Status		Mean (SD)	12.0 (1.28)
Yes	37 (90.2%)	**Change in HLA-G+ pEVs across pregnancy**	
No	3 (7.3%)	Mean (SD)	0.86 (0.79)
Missing	1 (2.4%)	**Gestational Age at Timepoint 1**	
Food Insecurity		Mean (SD)	12.4 (2.71)
Food insecure	7 (17.1%)	**Gestational Age at Timepoint 2**	
Food secure	34 (82.9%)	Mean (SD)	25.2 (3.01)
Pre-Pregnancy Body Mass Index (BMI)		**Smoker**	
Mean (SD)	30.1 (6.78)	Yes	8 (19.5%)
Missing	5 (12.2%)	No	33 (80.5%)
Gravidity (Number of Times Pregnant)		**Preeclampsia?**	
Mean (SD)	3.17 (2.55)	Yes	4 (9.8%)
Parity		No	35 (85.4%)
Nulliparous	16 (39.0%)	Missing	2 (4.9%)
Parous	25 (61.0%)	**Gestational Diabetes?**	
Clinical Depression (EDPS Sum >10)		Yes	9 (22.0%)
Clinically Depressed	7 (17.1%)	No	30 (73.2%)
Not Depressed	34 (82.9%)	Missing	2 (4.9%)

Table 2.1 caption: Cohort characteristics are shown in the ways most relevant for each variables. Columns 3 and 4 represent a continuation of columns 1 and 2, respectively.

3.2 Placental EV Quantity Changes Across Gestation

We observed a cohort-wide decline in pEV quantity across gestation. The mean (SD) pEV quantity was 12.7 (1.24) at timepoint 1 and 12.0 (1.28) at timepoint 2 (Table 2.1), with an average change in pEVs of 0.86 (0.79). Our data suggest that HLA-G+ pEVs decrease across gestational age (Figure 2.2); (r= -0.28, p-value = 0.011).

Figure 2.2: The Relationship of Gestational Age and HLA-G+ pEV Quantity Across Pregnancy
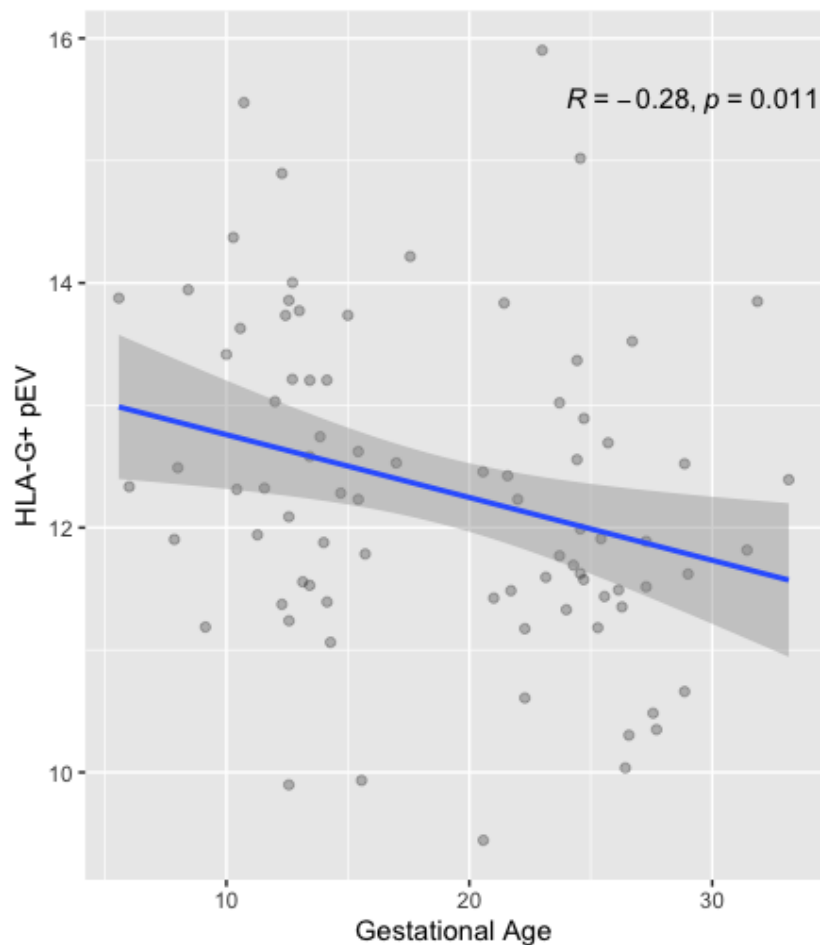
Figure 2.2 caption: We pooled participant data from both timepoints to assess the normative pattern of pEV dynamics across gestation. The blue line represents the calculated beta slope from each regression model, while the gray shaded region represents the 95% confidence intervals of the estimates. We find that HLA-G+ pEVs tends to drop from the first to the second timepoint (shown in figure; r= -0.28, p-value = 0.011). When controlling for participant ID, we similarly see a significant negative relationship between gestational age and HLA-G+ pEVs (β= -0.05, SE= 0.02, p-value= 0.012; not shown).

3.3 Placental EV Quantity Changes in Association with Psychological Distress

For Model 1, we compare early gestation psychological distress with (a) concurrent pEV quantity and (b) pEV quantity later in pregnancy. For Model 1a, we find no statistically significant relationship between early-gestation psychological distress and early-gestation pEV quantity (Table 2.2; Figure 2.3). For Model 1b, we find statistically significant negative relationships between early-gestation depression (*ß= -0.11; robust SE = 0.05; p-value = 0.023*) and anxiety (*ß= -0.13; robust SE = 0.06; p-value = 0.043)* (Table 2.3; Figure 2.3) with later-pregnancy pEV quantity.

Table 2.2: Model 1a Results

	Model 1a: Association between **depression** and **HLA-G+ pEV at Timepoint 1**	Model 1a: Association between **anxiety** and **HLA-G+ pEV at Timepoint 1**
Intercept	13.69*** (0.93)	13.51*** (1.06)
Depression (Timepoint 1)	-0.01 (0.04)	
Anxiety (Timepoint 1)		0.01 (0.06)
Gestational Age (Timepoint 1)	-0.08 (0.07)	-0.08 (0.06)
R²	0.03	0.03
Adj. R²	-0.02	-0.02
N	41	41

p < 0.001***; *p < 0.01**; p < 0.05**

Table 2.2 caption: The relationship of psychological distress (rows 2 and 3) on pEV quantity, adjusted for gestational age (row 4). Each cell contains the beta coefficient, with stars indicating significance level and robust standard errors in the parentheses. R^2 and Adjusted-R^2 and the total number of cases in each model are also presented. Overall model statistics are as follows (F-statistics; p-values): depression (0.58, 0.57), state anxiety (0.55, 0.58).

Table 2.3: Model 1b Results

	Model 1b: Association between **depression** and HLA-G+ pEV at Timepoint 2	Model 1b: Association between **anxiety** and HLA-G+ pEV at Timepoint 2
Intercept	13.14^{***}	14.45^{***}
	(1.76)	(2.13)
Depression (Timepoint 1)	-0.11^{*} (0.05)	
Anxiety (Timepoint 1)		-0.13^{*} (0.06)
Gestational Age (Timepoint 1)	-0.03 (0.08)	-0.05 (0.08)
Gestational Age (Timepoint 2)	-0.02 (0.06)	-0.03 (0.07)
R^2	0.14	0.10
Adj. R^2	0.07	0.02
N	41	41

$p < 0.001^{***}$; $p < 0.01^{**}$; $p < 0.05^{*}$

Table 2.3 caption: The relationship of psychological distress (rows 2 and 3) on pEV quantity, adjusted for gestational age (rows 4-5). Each cell contains the beta coefficient, with stars indicating significance level and robust standard errors in the parentheses. R^2 and Adjusted-R^2 and the total number of cases in each model are also presented. Overall model statistics are as follows (F-statistics; p-values): depression (1.96, 0.14), state anxiety (1.32, 0.28).

Figure 2.3: Marginal Effects of Depression and Anxiety in Early Gestation on HLA-G+ pEV Quantity in Later Gestation
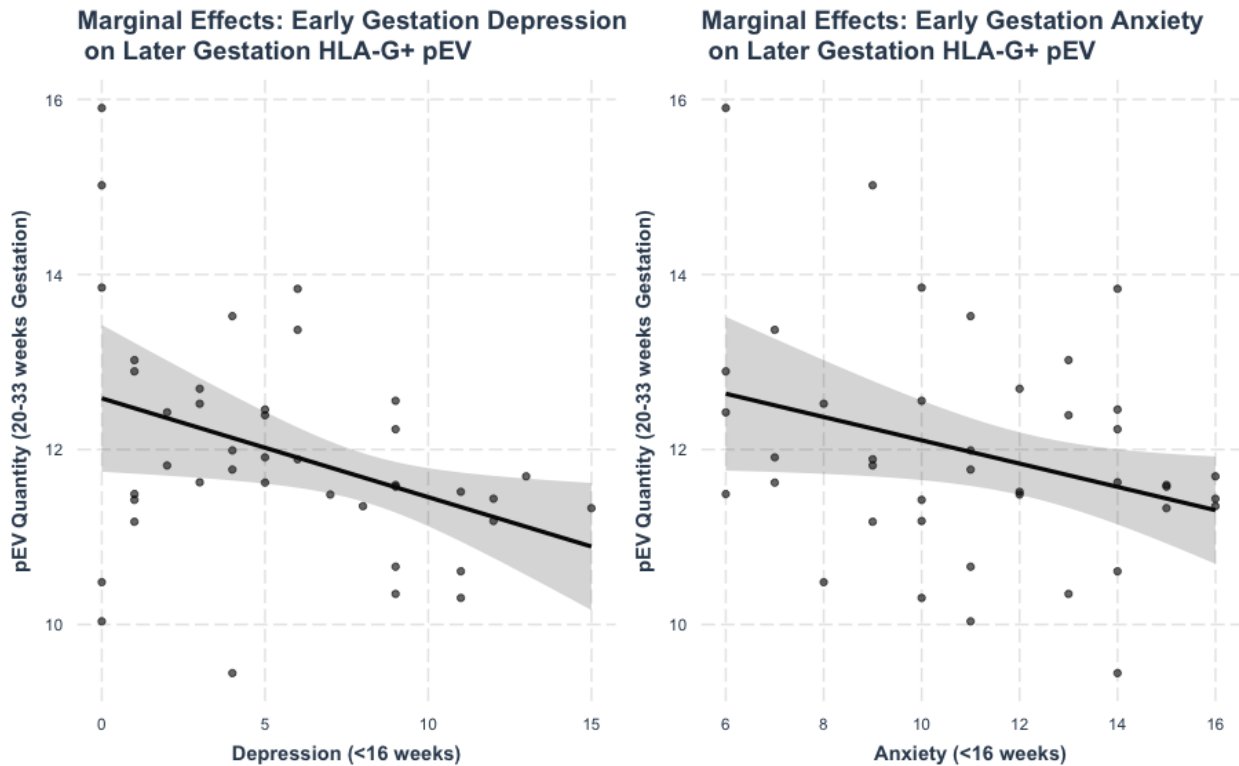
Figure 2.3 caption: These marginal effects plots show the relationship between psychological distress and pEV quantity. Psychological distress is operationalized as depression (measured with EPDS; left panel) and anxiety (measured with STAI-SF; right panel). The black line represents the calculated beta slope from each regression model, while the gray shaded region represents the 95% confidence intervals of the estimates. These regression plots control for the gestational age at the time of biological sample collection. Thus, these plots show the relationship between psychological distress and HLA-G+ pEVs above and beyond any effects of gestational age.

For Model 2, we compare early gestation psychological distress with a change in pEV quantity across pregnancy. We find a statistically significant relationship between early-gestation depression and our measure of change in pEV quantity across pregnancy (β=-0.07, robust SE = 0.03, p-value=0.021). The results of early-gestation anxiety and change in pEV were null (Table 2.4).

Table 2.4: Model 2 Results

	Model 2: Association between **depression** and **change in HLA-G+ pEV**	Model 2: Association between **anxiety** and **change in HLA-G+ pEV**
Intercept	0.47 (0.91)	1.06 (1.31)
Depression (Timepoint 1)	-0.07* (0.03)	
Anxiety (Timepoint 1)		-0.07 (0.05)
Gestational Age (Timepoint 1)	0.06 (0.04)	0.05 (0.04)
Change in Gestational Age	0.01 (0.03)	0.00 (0.03)
R²	0.18	0.11
Adj. R²	0.11	0.04
N	41	41

p < 0.001; p < 0.01; p < 0.05

Table 2.4 Caption: The relationship of psychological distress (rows 2 and 3) on the change of pEV quantity, adjusted for gestational age (rows 4-5). Each cell contains the beta coefficient, with stars indicating significance level and robust standard errors in the parentheses. R^2 and Adjusted-R^2 and the total number of cases in each model are also presented. Overall model statistics are as follows (F-statistics; p-values): depression (2.62, 0.06), state anxiety (1.59, 0.21).

3.4 Potential Confounders

We control for gestational age in all models, as it potentially influences both reported levels of psychological distress and the release of pEVs. Given our small sample size, we lack the power to include many more control variables. Nonetheless, we explored whether batch (date of assay) or operator effects were possible confounders through group variance tests. We find that our statistically significant results are not an artifact of operator or batch effects (Appendix A.4.3). We also check if our results are substantially altered by the addition of pre-pregnancy body mass index, preeclampsia, and gestational diabetes as possible confounders. We found that all beta values remained in the same direction, although p-values were sometimes (not always) larger. These p-value changes are to be expected due to adding more variables into models with small sample sizes (Appendix A.4.4). Overall, there is no evidence that their inclusion changes the pattern of results.

4. Discussion

While pregnancy complications have been associated to psychological distress and the quantity/cargo of placental extracellular vesicles (pEVs) independently (Dole, 2003; Grigoriadis et al., 2013, 2018; Grote et al., 2010; Hinkle et al., 2016; Kurki et al., 2000; Qiu et al., 2007; Salomon et al., 2017; Menon et al., 2019), there has not yet been a direct assessment of the relationship between psychological distress and pEVs. This study offers the first exploration into such associations, offering a step towards understanding how stress can become embodied and alter feto-placental development in ways that lead to adverse birth outcomes.

We collected plasma samples at two timepoints (early-gestation, $\mu=12$ weeks; and later-gestation, $\mu=25$ weeks) for each of the 41 pregnant women in our analytic cohort. Pregnancy is a dynamic physiological period; thus, it was important to first establish a baseline between our outcome measure, pEVs, and gestational age. We find HLA-G+ pEV quantity to drop from the first to the second timepoint (Figure 2.2). Orozco et al. similarly find the highest levels of HLA-G+ pEVs early in pregnancy.

We find that exposure to greater levels of both anxiety and depression in early gestation is associated with less HLA-G+ pEV quantity later in pregnancy and, for depression only, across pregnancy. This suggests that psychological distress may alter the trajectory of placental EVs across gestation through fewer or less active extravillous trophoblasts. These results begin to unpack the complicated biological connection of psychological distress and adverse birth outcomes previously established in the literature. In light of Model 1, Model 2 results are likely driven by later-gestation changes in pEV quantity.

The maternal body may experience an overload of somatic maintenance when enduring high rates of psychological distress. Many different biological pathways (e.g., metabolic,

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hormonal, inflammatory, oxidative) may be involved in altering EV release and quantity. The association of anxiety and depression with lower pEVs suggests that there is a dysregulation of EV quantity across gestation, which may dampen placental signaling. This stress-associated impairment of pEV release likely relates to impaired extravillous trophoblast activity, which may in turn have a negative impact on fetal growth, explaining the widely-observed associations between psychological distress and adverse birth outcomes.

The relationship between greater levels of prenatal maternal psychological distress with fewer pEVs is specific to the cell-type proxied in this study (i.e., HLA-G+ pEVs from extravillous trophoblasts). PLAP+ pEVs are the most commonly studied pEVs during pregnancy, and are derived from synciotrophoblasts, a broader cell-type of the placenta, some of which eventually differentiate into extravillous trophoblasts. PLAP+ pEVs have been shown to increase across gestation (Adam et al., 2017; Sarker et al., 2014), and are released in higher levels among pregnancies complicated by diseases such as preeclampsia and gestational diabetes (Salomon et al., 2016, 2017). Thus, there is an exacerbation of the normative pattern of pEV release across gestation (a rise in PLAP+ pEVs with gestational age, and greater PLAP+ pEV release) with pregnancy complications. There is less work surrounding HLA-G+ pEVs across gestation; however, Orozco et al. show that HLA-G+ EVs are highest in first trimester and decrease in second and third trimesters (2009). Our study similarly depicts a trend of intensification, in that the normative decrease of HLA-G+ EVs across pregnancy is magnified in pregnancies experiencing greater levels of stress. However, more research is needed to confirm.

The onset of psychological distress may or may not begin in pregnancy (Fishell, 2010), and we do not have a pre-pregnancy baseline assessment of psychological distress. Some work suggests that maternal mental health remains stable from preconception to prenatal period (Kee et

al., 2021); however, we do not know if depression or anxiety symptoms worsened or lessened across the life course for these particular women. We are limited to a small cohort and thus our results are only exploratory until replicated. The longitudinal matched-sample design in Model 2 and inclusion of early pregnancy timepoint are strengths of the study design. However, the observational design limits our ability to determine causality and only provides correlations and hypotheses for future work. Future studies are needed to determine causal mechanisms that link maternal mood with placental growth and function.

EV quantity and cargo are burgeoning diagnostic tools for women at risk for pregnancy complications. In the U.S., minority obstetric health disparities are of growing importance as maternal-offspring health exhibits a national declining trend (Hill et al., 2022). Systemic societal stressors play a role in obstetric disparities and more work is needed to consider the broader socio-cultural-political context of these individuals as well as their experiences within their unique social worlds. This chapter takes a novel approach in interpreting patterns of prenatal health and disease among Latina women by integrating a biocultural approach with cutting-edge molecular methods.

Appendix A: Supplemental Materials for Chapter 2

A.1 Methods: Operationalization of variables

The Edinburgh Postnatal Depression Scale (EPDS; (Cox et al., 1987; Murray & Carothers, 1990) consists of 10 items measured on a 4-point scale. Each item was anchored on a 0–3-point scale (0 - "*No, never*" and 3 - "*Yes, most of the time*"). The UCLA IRB requested that we drop the 10th item ("*The thought of harming myself has occurred to me*"/ "*He pensado en hacerme daño*"), due to the risks involved of asking about self-harm without offering follow-up psychiatric care. To honor this request, we use only the first 9 items of the EPDS scale, reproduced below in Table S1. Given the common concerns of the self-harm item in the EPDS, as stated in the manuscript, statistical analyses conducted by (Qiu et al., 2023) show that the 10-item and 9-item EPDS are highly correlate with strong sensitivity.

Supplemental Table S1: Item Breakdown of EPDS Scale used in Wave 2 MCE studies

Reverse Coded	EPDS Scale Item Text	
	English	**Spanish**
	I have been able to laugh and see the funny side of things	He podido reír y ver el lado gracioso de las cosas
	I have looked forward with enjoyment to things	He mirado al futuro con placer para hacer cosas
x	I have blamed myself unnecessarily when things went wrong	Me he culpado sin necesidad cuando las cosas marchaban mal
	I have been anxious or worried for no good reason	He estado ansiosa y preocupada sin motivo
x	I have felt scared or panicky for no very good reason	He sentido miedo o pánico sin motivo alguno
x	Things have been getting on top of me	Las cosas me oprimen o agobian
x	I have been so unhappy that I have had difficulty sleeping	Me he sentido tan infeliz, que he tenido dificultad para dormir

x	I have felt sad or miserable	Me he sentido triste y desgraciada
x	I have been so unhappy that I have been crying	Me he sentido tan infeliz que he estado llorando

The Spielberger State-Trait Anxiety Inventory State scale (STAI; validated among pregnant women by (Marteau & Bekker, 1992), consists of six items, three of which are reversed coded, and anchored on a 4-point scale (1 = *Not at all* to 4 = *Very much*) with items like, "*I am worried*" and "*I feel upset.*"

Supplemental Table S2 Item Breakdown of STAI-SF Scale

Reverse Coded	STAI-SF Item Text	
	English	**Spanish**
x	I feel calm	Me siento calmada
	I feel upset	Me siento disgustada
x	I feel content	Me siento contenta
x	I am relaxed	Estoy relajada
	I am worried	Estoy preocupada
	I am tense	Estoy tensa

A.2 Mental Health Thresholds

The clinically significant cut-off thresholds presented in this chapter were calculated the following ways. For the EPDS, scores were calculated based on a summation of individual items. These summary scores range from 0-30 when all 10 items are included, and 0-27 when the self-harm question is dropped. Scores greater than 10 were identified as likely for at least minor depression. While there is some debate over the proper cut-off score to use, a validation of the 10-item EPDS among Spanish-speaking women suggests a cut-off threshold of 10 or 11 (Garcia-Esteve et al., 2003). Validation of the 10-item EPDS in a community sample of postnatal women against a diagnostic clinical interview found a positive predictive value of 73% of women scoring

>10 (with 86% sensitivity) (Murray & Carothers, 1990). By dropping the 10th item of the EPDS, as required by the IRB, our cut-off of >10 is an even more conservative estimation of the number of women in our sample who may be experiencing symptoms of clinical depression.

For STAI-SF scale, scores were also based on a sum of individual items, with a range of 6-24. In the full-length scales, women range 20-80, and the broader literature often describes women with scores ≥ 40 as likely to have clinical levels of anxiety (Julian, 2011). We use a mean score with STAI-SF and extrapolate their methods to describe scores of 2 or greater as associated with clinical levels of anxiety (equivalent to a sum score of >12). The same cut-off has been used elsewhere (Micallef et al., 1998). Since this dichotomization is only used for descriptive presentation of the cohort (e.g., Table 2.1 and Supplementary Tables S4-5).

A.3 Titration Study on Placental Extracellular Vesicle Assay

By conducting a dilution titration experiment with one sample of our 41 participants, run in duplicate, we find a clear linear relationship between amount of plasma used and HLA-G+ pEV quantified by our methods. This supports the validity of the methods used.

Supplemental Figure S1: Plasma Titration Results
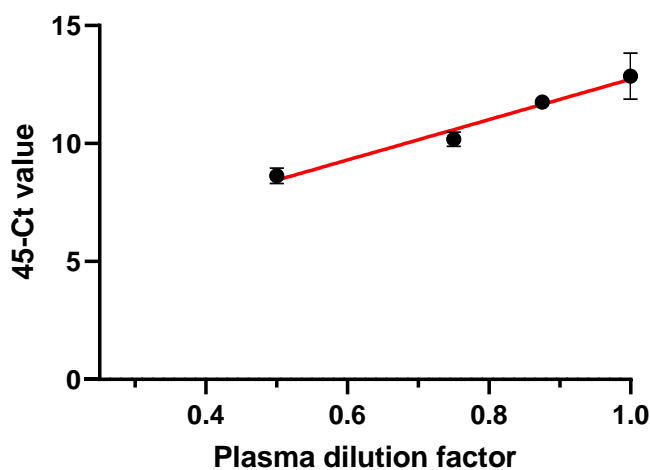
Supplemental Figure S1 caption: This graph shows a strong linear relationship (red line) of HLA-G+ placental EV quantity (calculated by 45-Ct-value) by volume of participant plasma used (plasma dilution factor), indicating strong methodological validity.

A.4 Results

Supplemental Figure S2: Selection of Analytic Cohort
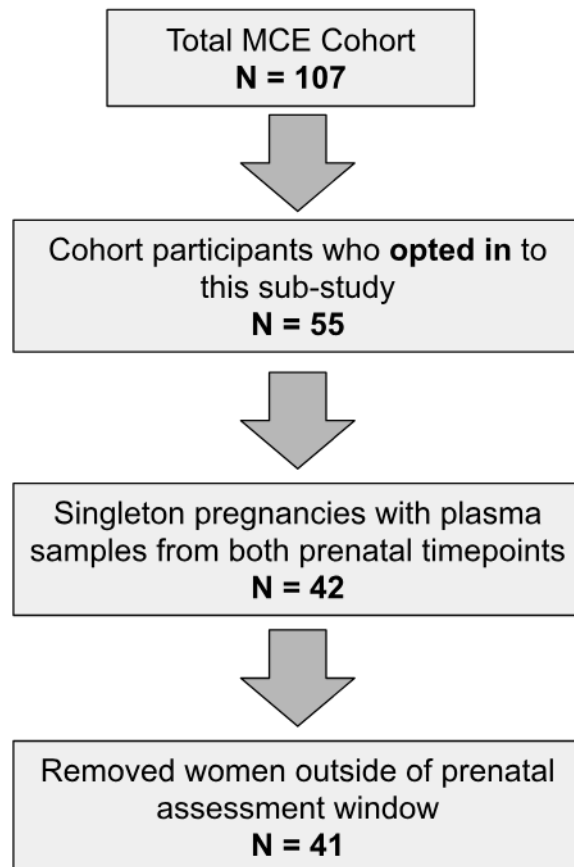
Supplemental Figure S2 caption: Of the 107 women enrolled in Wave 2 of the MCE cohort, only 55 women additionally consented to a sub-study on genetics, placental cells, and parts of placental cells. Of these women, only 42 women had singleton pregnancies and plasma samples donated at both their prenatal timepoints. One additional participant was removed due to a prenatal assessment collected outside of the target timepoint window due to a scheduling error, leaving a total analytic cohort of N=41.

A.4.1 Cohort Characteristics Split on Mental Health Cut-Offs

In Supplemental Table S4 and S5, we conducted t-tests and chi-squared tests to compare depressed versus non-depressed women and anxious versus non-anxious women in the cohort. The p-values (third column) reveal that there is no statistically significant difference between these groups in their general characteristics. There is a statistically significant difference between

depressed and non-depressed women when it comes to HLA-G+ pEV quantity at Timepoint 2 and the change in pEV quantity across gestation (Table S3), the remainder of the table variables are non-significant.

Supplemental Table S3: Depressed versus Not Depressed Women in Cohort

	Clinically Depressed (N=7)	Not Depressed (N=34)	P-value (t-test of depressed versus non-depressed)
Age (years)			
Mean (SD)	29.4 (5.28)	31.0 (5.54)	0.48
Median [Min, Max]	28.6 [21.7, 37.5]	30.3 [21.9, 41.8]	
Country of Origin			
U.S.	5 (71.4%)	14 (41.2%)	0.326
Mexico	1 (14.3%)	13 (38.2%)	
Other Latin American Country	1 (14.3%)	7 (20.6%)	
Education			
Less than High School	1 (14.3%)	6 (17.6%)	NA
High School or Equivalent	6 (85.7%)	28 (82.4%)	
More than High School	0 (0%)	0 (0%)	
Relationship Status			
Yes	6 (85.7%)	31 (91.2%)	1
No	1 (14.3%)	2 (5.9%)	
Missing	0 (0%)	1 (2.9%)	
Food Insecurity			
Food insecure	1 (14.3%)	6 (17.6%)	1
Food secure	6 (85.7%)	28 (82.4%)	
Pre-Pregnancy Body Mass Index (BMI)			
Mean (SD)	29.3 (9.94)	30.3 (6.35)	0.841
Median [Min, Max]	25.8 [18.0, 41.8]	29.2 [20.2, 49.1]	
Missing	2 (28.6%)	3 (8.8%)	
Gravidity (Number of Times Pregnant)			

	Clinically Depressed (N=7)	Not Depressed (N=34)	P-value (t-test of depressed versus non-depressed)
Mean (SD)	3.43 (2.99)	3.12 (2.50)	0.804
Median [Min, Max]	2.00 [1.00, 9.00]	3.00 [1.00, 14.0]	
Parity			
Nulliparous	3 (42.9%)	13 (38.2%)	1
Parous	4 (57.1%)	21 (61.8%)	
Anxiety at Timepoint 1			
Anxious	4 (57.1%)	11 (32.4%)	0.418
Not Anxious	3 (42.9%)	23 (67.6%)	
HLA-G+ pEV at Timepoint 1 (per 100 μL of plasma)			
Mean (SD)	12.8 (1.06)	12.6 (1.29)	0.666
Median [Min, Max]	12.7 [11.1, 14.2]	12.5 [9.90, 15.5]	
HLA-G+ pEV at Timepoint 2 (per 100 μL of plasma)			
Mean (SD)	11.2 (0.509)	12.1 (1.33)	0.003
Median [Min, Max]	11.3 [10.3, 11.7]	11.9 [9.44, 15.9]	
Change in HLA-G+ pEVs across pregnancy			
Mean (SD)	0.364 (0.215)	0.966 (0.827)	<0.001
Median [Min, Max]	0.272 [0.154, 0.730]	0.736 [0.160, 3.73]	
Gestational Age at Timepoint 1			
Mean (SD)	11.9 (4.50)	12.5 (2.27)	0.725
Median [Min, Max]	13.9 [5.57, 17.6]	12.6 [7.86, 17.0]	
Gestational Age at Timepoint 2			
Mean (SD)	25.0 (1.68)	25.3 (3.23)	0.788
Median [Min, Max]	25.3 [22.3, 27.3]	24.6 [20.6, 33.1]	
Smoker			
Yes	0 (0%)	8 (23.5%)	0.364
No	7 (100%)	26 (76.5%)	
Preeclampsia			
Yes	1 (14.3%)	3 (8.8%)	1

	Clinically Depressed (N=7)	Not Depressed (N=34)	P-value (t-test of depressed versus non-depressed)
No	6 (85.7%)	29 (85.3%)	
Missing	0 (0%)	2 (5.9%)	
Gestational Diabetes			
Yes	1 (14.3%)	8 (23.5%)	0.909
No	6 (85.7%)	24 (70.6%)	
Missing	0 (0%)	2 (5.9%)	

Supplemental Table S3 Caption: Timepoint 1 is the first prenatal assessment occurring at recruitment (<16 weeks) and Timepoint 2 is the second prenatal assessment (22-28 weeks gestational age). Column three conducts t-tests (where possible) of each cohort characteristic for the clinically depressed (EPDS > 10) and non-depressed subgroups. See Section A.2 for description of cut-off thresholds.

Supplemental Table S4: Anxious versus Not Anxious Women in Cohort

	Anxious (N=15)	Not Anxious (N=26)	P-value (t-test of anxious versus non-anxious)
Age (years)			
Mean (SD)	31.2 (5.65)	30.5 (5.46)	0.716
Median [Min, Max]	29.6 [23.5, 41.8]	30.2 [21.7, 41.4]	
Country of Origin			
U.S.	5 (33.3%)	14 (53.8%)	0.144
Mexico	8 (53.3%)	6 (23.1%)	
Other Latin American Country	2 (13.3%)	6 (23.1%)	
Education			
Less than High School	3 (20.0%)	4 (15.4%)	NA
High School or Equivalent	12 (80.0%)	22 (84.6%)	
More than High School	0 (0%)	0 (0%)	
Relationship Status			
Yes	13 (86.7%)	24 (92.3%)	0.642
No	2 (13.3%)	1 (3.8%)	
Missing	0 (0%)	1 (3.8%)	
Food Insecurity			
Food insecure	3 (20.0%)	4 (15.4%)	1

	Anxious (N=15)	Not Anxious (N=26)	P-value (t-test of anxious versus non-anxious)
Food secure	12 (80.0%)	22 (84.6%)	
Pre-Pregnancy Body Mass Index (BMI)			
Mean (SD)	28.6 (5.96)	31.0 (7.18)	0.290
Median [Min, Max]	29.1 [18.0, 41.8]	30.4 [20.2, 49.1]	
Missing	2 (13.3%)	3 (11.5%)	
Gravidity (Number of Times Pregnant)			
Mean (SD)	4.13 (3.50)	2.62 (1.63)	0.131
Median [Min, Max]	4.00 [1.00, 14.0]	2.00 [1.00, 6.00]	
Parity			
Nulliparous	6 (40.0%)	10 (38.5%)	1
Parous	9 (60.0%)	16 (61.5%)	
Clinical Depression (EDPS Sum >10) at Timepoint 1			
Clinically Depressed	4 (26.7%)	3 (11.5%)	0.418
Not Depressed	11 (73.3%)	23 (88.5%)	
HLA-G+ pEV at Timepoint 1 (per 100 μL of plasma)			
Mean (SD)	12.7 (1.57)	12.6 (1.04)	0.775
Median [Min, Max]	12.3 [9.90, 15.5]	12.6 [9.93, 14.2]	
HLA-G+ pEV at Timepoint 2 (per 100 μL of plasma)			
Mean (SD)	11.7 (1.07)	12.1 (1.37)	0.230
Median [Min, Max]	11.6 [9.44, 13.8]	11.9 [10.0, 15.9]	
Change in HLA-G+ pEVs across pregnancy			
Mean (SD)	0.695 (0.787)	0.960 (0.790)	0.308
Median [Min, Max]	0.541 [0.160, 3.31]	0.736 [0.154, 3.73]	
Gestational Age at Timepoint 1			
Mean (SD)	11.9 (2.47)	12.7 (2.85)	0.331
Median [Min, Max]	12.3 [5.57, 15.4]	12.9 [6.00, 17.6]	

	Anxious (N=15)	Not Anxious (N=26)	P-value (t-test of anxious versus non-anxious)
Gestational Age at Timepoint 2			
Mean (SD)	24.3 (3.19)	25.8 (2.81)	0.137
Median [Min, Max]	24.0 [20.6, 33.1]	25.6 [21.0, 31.9]	
Smoker			
Yes	3 (20.0%)	5 (19.2%)	1
No	12 (80.0%)	21 (80.8%)	
Preeclampsia			
Yes	2 (13.3%)	2 (7.7%)	0.852
No	11 (73.3%)	24 (92.3%)	
Missing	2 (13.3%)	0 (0%)	
Gestational Diabetes			
Yes	2 (13.3%)	7 (26.9%)	0.687
No	11 (73.3%)	19 (73.1%)	
Missing	2 (13.3%)	0 (0%)	

Supplemental Table S4 Caption: Timepoint 1 is the first prenatal assessment occurring at recruitment (<16 weeks). Timepoint 2 is the second prenatal assessment occurring at their follow-up appointment (22-28 weeks gestational age). Column three conducts t-tests (where possible) of each cohort characteristic for the clinically anxious and non-anxious subgroups. Section A.2 for description of cut-off thresholds.

A.4.2 Gestational Age

Supplemental Figure S3: Directed Acyclic Graph of Potential Confounders
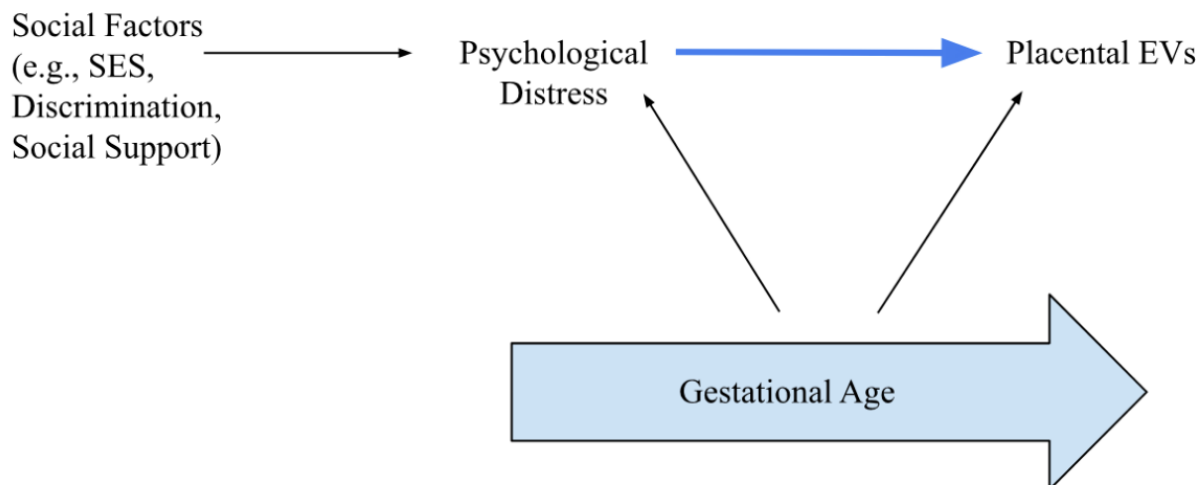
Supplementary Figure S3 Caption: Directed acyclic graph showing the proposed relationships between the variables of interest and potential confounders.

A.4.3 Operator and Batch Effects

Quantification with the EV-subpopulation assay at the UCLA Liquid Biopsy lab was conducted by two operators. The first two batches (or first two dates) were conducted with one operator and the remaining 10 batches were conducted with the second operator. Batch and operator effects are expected confounds for this manner of laboratory work. As described in the manuscript, the significant findings of Model 1 are replicated in Model 2. Model 2's design uses change in pEV quantity across gestation. Since both participant timepoints are always measured on the same day by the same operator, operator and batch confounding should be inherently controlled for with the change in pEV quantity variable, given its construction.

To be cautious, we conducted t-tests to compare the differences HLA-G+ pEV quantity between the two operators. We find that HLA-G+ pEV quantity was just significantly different between the two operators at timepoint 1 (t = -2.36, p-value = 0.05) and not statistically significant at timepoint 2 (t = -1.72, p-value = 0.14) or the change across pregnancy measure (t = -1.50, p-value = 0.15). Since our main findings were not significant for the cross-sectional analysis at timepoint 1, we do not further interrogate this issue.

For batch effects, we conducted two ANOVA tests exploring the relationship of HLA-G+ pEV quantity with date (a 12-level factor, where each date is a distinct batch). We find no statistical relationship between date and Ct-value at Timepoint 1 (Sum-Squares: 20.45, F-value: 1.30, p-value: 0.27). For date and Ct-value at Timepoint 2, the ANOVA test revealed a relationship between date and Ct-value (Sum-squares: 34.97, F-value: 3.05, p-value: 0.01). We also find no statistically significant relationship between date and the change in pEV across pregnancy measure (Sum-squares: 5.033, F-value: 0.667, p-value: 0.76). Since the batch effect is significant for timepoint 2, and we do find a significant effect in our main research question at timepoint 2, we

interrogate this further to make sure our main finding is not an artifact of batch effects. We added date as a control variable to our significant main finding (Model 1b). For Model 1b anxiety remained significant above and beyond the effect of date (anxiety β: -0.13, robust SE: 0.04, p-value: 0.002), while depression was just out of significance range, the betas remained with the same directions (depression β: -0.05, robust SE: 0.03, p-value: 0.081). The addition of a factor variable may also render the effect non-significant because of the power of the model given the low sample size. Thus, we conclude that operator and batch effects are not likely causing spurious results.

A.4.4 Possible Confounders

After running the models presented in the manuscript, it was suggested to us that our findings could be an artifact of increasing volume of blood during pregnancy. We already control for gestational age, which should remove any such effects. However, to explore this potential confound further, we evaluated the effect of pre-pregnancy body mass index (BMI) in the models. BMI is a known factor for influencing blood volume (Vricella et al., 2015).

The addition of pre-pregnancy BMI rendered the previously significant Model 1b insignificant (depression β: -0.071, robust SE: 0.04, p-value: 0.13; anxiety β:-0.072, robust SE: 0.04, p-value: 0.11). For Model 2, depression remained significant above the effect of pre-pregnancy BMI (β: -0.045, robust SE: 0.022, p-value: 0.047), and anxiety remained insignificant. Again, all the results maintained the same beta-value directions (negative), suggesting that the relationship between early-gestation psychological distress and later-gestation placental EV quantity is likely a true finding, but we are not powered to detect it with too many control variables. BMI may be a confounder that should be considered in future studies with larger sample sizes.

We also independently checked the effect of preeclampsia and gestational diabetes (GD) as confounders, since these are pregnancy complications associated with altered pEV quantity. T-tests revealed no difference of HLA-G+ pEVs between preeclamptic and non-preeclamptic women as well as between GD and non-GD women for any pEV outcome variable.

A.4.5 Regression Diagnostics

For Models 1 and 2, diagnostic plots indicate that the assumptions required for regression are reasonable as there are no strong pattern among residuals, which appear to be normally distributed, and there are no strong leverage points beyond the Cook's distance. Variance-inflation factors (VIF) were calculated to examine correlations between independent variables to quantify multicollinearity. While some scholars suggest a VIF of 5 or 10 to be problematic (Menard, 2002), others suggest a more conservative 2.5 limit (Johnston et al., 2018). All VIF scores for all variables in all models were below 2.0, indicating no issues of multicollinearity.

For all models, we conducted Breusch-Pagan tests, which tests the null hypothesis of homoskedasticity. We failed to reject the null hypothesis only the Model 1b depression model. However, we used robust standard errors in all models to account for heteroskedasticity where present and remain conservative in our estimates throughout.

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Chapter 3: An Evolutionary Perspective on the Association Between Grandmother-Mother Relationships and Maternal Mental Health

An evolutionary perspective on the association between grandmother-mother relationships and maternal mental health among a cohort of pregnant Latina women

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ABSTRACT

Grandmothers are often critical helpers during a mother's reproductive career. Studies on the developmental origins of health and disease demonstrate how maternal psychological distress can negatively influence fetal development and birth outcomes, highlighting an area in which soon-to-be grandmothers (henceforth "grandmothers") can invest to improve both mother and offspring well-being. Here, we examine if and how a pregnant woman's mental health– specifically, depression, state-anxiety, and pregnancy-related anxiety– is influenced by her relationship with her fetus' maternal and paternal grandmother, controlling for relationship characteristics with her fetus' father. In a cohort of pregnant Latina women in Southern California ($N = 216$), we assessed social support, geographic proximity, and communication between the fetus' grandmothers and pregnant mother. We assessed maternal mental health with validated questionnaire-based instruments. We find that both social support from and communication with the maternal grandmother were statistically associated with less depression, while no paternal grandmother relationship characteristics were statistically significant in association with any mental health variable. These results align with the idea that maternal grandmothers are more adaptively incentivized to invest in their daughters' well-being during pregnancy than paternal grandmothers are for their daughters-in-law. Results suggest that the positive association of maternal grandmothers with mothers' mental health may not hinge on geographic proximity, but rather, potentially function through emotional support. This work represents a novel perspective describing a psychological and prenatal grandmaternal effect.

1. Introduction

Maternal psychology relates to offspring fitness in many ways, including infant morbidity and mortality. The advancing field of development origins of health and disease (DOHaD) proposes a connection between maternal psychological distress, fetal development, and adverse infant outcomes creating an intergenerational connection linking these phenotypes. Under a DOHaD framework, factors that positively affect prenatal mental health should increase both maternal and offspring fitness. Evolutionary theory suggests that allomothers (i. e., helpers who are not the offspring's mother) positively influence the survival of the child. No work to date has investigated prenatal allomother influence on maternal psychology. Thus, this represents a new approach for integrating DOHaD with evolutionary theory.

Growing evidence suggests that maternal mental health has

consequences for offspring phenotypes at birth and later in life. Pregnancy is a period of vulnerability for the onset of maternal affective disorders, particularly depression and anxiety (Fishell, 2010). Prenatal stress, anxiety, and depression have been tied to low birth weight and preterm birth (Dunkel Schetter & Tanner, 2012; Grigoriadis et al., 2013; Grigoriadis et al., 2018; Grote et al., 2010; March of Dimes, 2015), both known causes of infant morbidity and mortality (Callaghan, MacDorman, Rasmussen, Qin, & Lackritz, 2006; Eshete, Alemu, & Zerfu, 2019). Prenatal exposures have also been linked to outcomes beyond birth, including developmental deficits and life-long chronic disease risk (Glynn et al., 2018; Glynn & Sandman, 2011; Kinsella & Monk, 2009; Leis, Heron, Stuart, & Mendelson, 2014). In a large-scale study of thousands of parent-offspring dyads, both prenatal and postnatal depression were each independently associated with offspring depression risk at age 18 (Pearson et al., 2013). Depression and other mood

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disorders have been tied to lower fertility of women, both in behaviors resulting in lower fertility rates and in reduced success of fertility treatment (Williams, Marsh, & Rasgon, 2007). Therefore, prenatal psychology can affect maternal fitness through fecundity/fertility, offspring morbidity and mortality at birth, and offsprings' lifelong health.

The costs of reproduction are offset by a flexible roster of allomothers across human societies, including by a child's father, aunts, grandparents, older siblings, as well as non-kin who have all been shown to benefit maternal reproductive success and child survival in some context (Crittenden & Marlowe, 2008; Kramer, 2005, 2010; Meehan, Helfrecht, & Quinlan, 2014). Despite this flexibility being key for human reproductive success, researchers have noted that allomaternal help from grandmothers is especially consistent and high-quality (Chapman, Pettay, Lahdenperä, & Lummaa, 2018; Emmott & Mace, 2015; Hrdy, 2005; Leonetti, Nath, Heman, & Niell, 2005; Scelza, 2009; Scelza & Hinde, 2019; Sear, 2018; Sear & Mace, 2008). Many evolutionary anthropologists have focused on grandmothers because of their genetic closeness to their grandchildren ($r = 0.25$). Additionally, the obligate cessation of fertility of older women (compared to the facultative fertility of older men) reduces competition with daughters (in-law) (Cant & Johnstone, 2008). The longstanding debate on the evolutionary origins of menopause (Hawkes, O'Connell, Jones, Alvarez, & Charnov, 1998; Peccei, 2005) is beyond our scope here. Grandmothers are valuable allomothers because they often have more reproductive experience and expertise than other kin categories, such as older siblings. After much focus on grandmothers being critical to the weaning period, evolutionary scholarship has expanded to show grandmothers as critical throughout a woman's reproductive career including at birth (Rosenberg & Trevathan, 2002) and during breastfeeding (Myers, Page, & Emmott, 2021; Scelza & Hinde, 2019). The prenatal period is just as vulnerable, yet underexplored, perhaps due to theoretical focus on the fetus rather than the mother. Pregnancy brings about unique challenges for the mother, such as psychological and physiological transitions, new social roles, and among market-integrated societies: new forms of discrimination, financial strains, and medical systems to navigate. The connections that DOHaD highlights between mother and offspring during pregnancy implies motivations for grandmaternal influence that are not obvious and should be explored. We refer to these motivations as 'adaptive interests' and these influences on fitness outcomes, including decreasing mortality risk and increasing mate-quality at adulthood, as simply 'benefits to the developing offspring'.

In this study, we explicitly measure the association of grandmaternal relationship characteristics with maternal prenatal mental health to gauge whether there exists an adaptive interest in maintaining maternal well-being during gestation for both allomothers. The literature suggests maternal grandmothers (MGMs) are associated with decreased grandchild mortality than paternal grandmothers (PGM) (Coall & Hertwig, 2010; Sear & Mace, 2008; Strassmann & Garrard, 2011). Based on this, we predict MGMs will positively influence maternal prenatal mental health, as there are direct and inclusive fitness benefits to both pregnant daughter and fetus (i.e., grandoffspring). The story is less clear for PGMs. Benefits to maternal prenatal psychology may improve sons' and grandoffspring fitness, but potentially at cost to the PGM's own daughters when finite resources are transmitted to sons' families. Thus, we are agnostic about PGMs' influence on maternal prenatal mental health as there are social and evolutionary reasons why it may be neutral or even negative despite the adaptive advantage of help to the grandoffspring during gestation.

Each allomother relationship characteristic (social support, geographic proximity, communication) captures a unique aspect of the grandmother-mother relationship that may impact maternal mental health. Social support is the care provided by or potentially available from a known individual; this support can be emotional (e.g., listening), informational (e.g., guidance), or instrumental (e.g., provisioning) (Dunkel Schetter & Brooks, 2009). While social support is often studied in psychology, anthropologists describe such acts of care with different

terminology, such as allomaternal care and often through a lens of cooperative breeding (e.g., Emmott, Myers, & Page, 2021). Previous research has shown that instrumental and emotional support can impact perinatal outcomes differently (Bedaso, Adams, Peng, & Sibbritt, 2021; Emmott & Mace, 2015). Emotional support buffers against negative psychological and physiological states and improves psychological resilience in both pregnant and non-pregnant cohorts (Bedaso et al., 2021; Reblin & Uchino, 2008; Seguin, Potvin, Stdenis, & Loiselle, 1995; Suls & Wallston, 2003). Instrumental support has been shown to buffer stress during pregnancy (Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993) and improve well-being only if emotional support is also present (Morelli, Lee, Arnn, & Zaki, 2015). Other studies have tied greater levels of social support to a range of positive birth outcomes in the U.S. (Collins et al., 1993; Elsenbruch et al., 2007; Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000) and to reduced infant mortality in Mexico (Kana'Iaupuni, Donato, Thompson-Colón, & Stainback, 2005) likely through moderation of HPA-axis. These studies on birth outcomes often use psychometric scales of perceived social support that were designed to capture a combination of instrumental and emotional support. While instrumental support is often the metric used in allomother research, emotional support may serve a more critical role to buffer stress during pregnancy.

Ethnographic studies on the relationship between allomaternal support and offspring fitness often do not measure any kind of social support directly, but rather use survival or geographic proximity as a proxy for grandmaternal involvement (Callaghan et al., 2006; Eshete et al., 2019). Greater geographic proximity between grandmother-mother-offspring is usually associated with increased offspring survival (Chapman et al., 2018; Engelhardt, Bergeron, Gagnon, Dillon, & Pelletier, 2019). However, these connections are often studied in historical populations where geographic proximity was a pre-requisite for all forms of social support. Today, individuals are able to offer financial, informational, and emotional support from great distances. Geographic proximity may still be a good proxy variable for instrumental support and an important variable to include for its extensive use in the anthropological literature. By analyzing other variables in tandem with geographic proximity, we gain a broader picture of grandmother-mother relationships.

Communication is a critical way for emotional and informational support to be delivered. In a study of immigrant Mexican women aged 35–50, higher levels of communication with family were related to increased perceived emotional support (Vega, Kolody, Valle, & Weir, 1991). However, not all communication is good and an excessively involved caregiver can be burdensome. For example, one study found grandmother-mother verbal conflict to be independently associated with negative maternal parenting and child behavioral problems (Barnett, Mills-Koonce, Gustafsson, Cox, & Investigators, 2012). Here, we explore the independent contributions of communication, which allows us to consider the positive and negative ways allomothers may influence maternal psychology.

This project focuses on Latina women living in Southern California. 'Latino/a' is an ethnic category describing people with heritage from Latin America; the broad term thus includes extensive cultural diversity. We explore grandmother-mother relationships among Latinas in the U.S. because of certain trends associated with family life. Latinos in the U.S. have the highest rates of three-generation homes (i.e., grandparents and grandchildren who live together) compared to other ethnic groups (Cohn & Passel, 2018; PEW Research Center, 2010). Simultaneously, Latinos have the highest rates of cross-border families in the U.S. due to being the largest immigrating minority (PEW Research Center, 2020). High rates of both shared homes and cross-border families creates the opportunity to differentiate between the effects of geographic proximity and communication. The cross-cultural importance of family among Latino cultural groups (*familismo*) means that individuals often make family life a priority at greater rates than the broader U.S. population (Campos et al., 2008). Additionally, the cross-cultural values of

machismo and *marianismo* among Latinos structure gender roles that cast women as primary caregivers (Nuñez et al., 2016), see Supplemental Materials (SM) for notes on these cultural values. Finally, working in a post-demographic transition society may make grandparental care more valuable, as Coall and Hertwig (2011) argue, a low-fertility, low-mortality context makes grandparental care even more valuable. Fewer offspring means fewer opportunities to pass on ones' genes, so the evolved sense to invest in each grandoffspring may be greater.

2. Methods

2.1. Cohort

The present work utilizes data from Wave 1 of Mothers' Cultural Experiences (MCE) study. MCE Wave 1 examines the influence of social, cultural, and environmental stressors on maternal psychology and fetal/infant development from 361 pregnant and postpartum women who were recruited from clinic waiting rooms or breastfeeding classes at four sites in Southern California. Participants completed an anonymous survey in either English or Spanish. This study was approved by the Institutional Review Boards of all participating institutions with appropriate reliances. Procedures comply with the tenets of the Declaration of Helsinki. Data is not publicly available because participants did not consent to sharing individual-level data publicly.

For the analyses here, participants were omitted because they were determined to not be eligible ($N = 13$), did not receive social support scales in their survey versions ($N = 87$), or were postnatal ($N = 69$), leaving an analytic cohort of $N = 216$.

2.2. Operationalization of variables

In this study, "maternal grandmother" (MGM) is the woman who raised the participant, "father" is the person whom the participant thinks will be the baby's main father figure, and "paternal grandmother" (PGM) is the participant's baby's father's mother. While the PGM may or may not be the participants' mother-in-law, we use the terms mother- or daughter-in-law to refer to this relationship regardless of marital status. We include adoptive parents along with birth parents based on the argument that social categories are an appropriate replacement for genetic categories because the cognitive responses elicited by the evolved human brain are expected to be similar, if not the same, for socio-cultural categories of 'mother' and 'child' (Bogin, Bragg, & Kuzawa, 2014). Non-biological MGMs account for <5% of the sample (Table 1).

This study measures mental health through the following inventories validated for use among pregnant women: (i) Edinburgh perinatal depression scale (EPDS) (Cox, Holden, & Sagovsky, 1987; Santos et al., 2007), (ii) the state form of the Spielberger state-trait anxiety short form scale (STAI-SF) (Barnett et al., 2012; Tluczek, Henriques, & Brown, 2009), (iii) pregnancy-related anxiety scale (PRA) (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). All mental health variables were treated continuously. For a breakdown of the items used in the instruments, see Tables S1–4.

The EDPS scale consists of 10-items measured on a 4-point scale, such as "*I have been so unhappy that I have had difficulty sleeping.*" A sum of all items gives a range of EPDS scores from 0 to 30. Cronbach alpha, a measure of the internal consistency of self-report scales, for EPDS among our cohort was $\alpha = 0.85$ (English $\alpha = 0.86$, Spanish $\alpha = 0.84$).

The STAI-SF scale consists of six items, such as "*I am worried*", which are anchored on a 4-point scale (total $\alpha = 0.81$, English $\alpha = 0.84$, Spanish $\alpha = 0.77$). The STAI-SF mean score ranges from 1 to 4. Clinically significant cut-off thresholds for depression and anxiety are described in SM.

The 10-item PRA scale assesses worries over pregnancy and baby's health with items such as "*I am concerned or worried about how the baby is growing and developing inside me*". These items are anchored on a 4-point

Table 1

Demographics of the study cohort and descriptive statistics of the measures used in this study. SD: standard deviation. See Supplemental Materials for explanation of clinically significant cut-off scores.

	Total (N = 216)
Age (years)	
Mean (SD)	29.8 (6.12)
Missing	13 (6.0%)
In a relationship?	
Yes	188 (87.0%)
No	23 (10.6%)
Missing	5 (2.3%)
Parity	
Nulliparous	71 (32.9%)
Parous	138 (63.9%)
Missing	7 (3.2%)
Education	
Less than high school	30 (13.9%)
High school or equivalent	142 (65.7%)
More than high school	36 (16.7%)
Missing	8 (3.7%)
Trimester	
First	17 (7.9%)
Second	47 (21.8%)
Third	131 (60.6%)
Missing	21 (9.7%)
Food secure	
Yes	108 (50.0%)
No	82 (38.0%)
Missing	26 (12.0%)
Country of origin	
U.S.	94 (43.5%)
Mexico	92 (42.6%)
El Salvador	12 (5.6%)
Guatemala	7 (3.2%)
Another country	6 (2.8%)
Missing	5 (2.3%)
Do you know who your baby's biological father is (or probably is)?	
Yes	199 (92.1%)
No	9 (4.2%)
Missing	8 (3.7%)
Is your baby's biological father, your current relationship partner?	
Yes	178 (82.4%)
No	5 (2.3%)
Does not apply, not in a romantic relationship	24 (11.1%)
Missing	9 (4.2%)
Who do you think of as your mother?	
My birth mother raised me	201 (93.1%)
I was adopted and I'm not a blood relative of my parents	1 (0.5%)
Someone else I think of as a mother raised me	6 (2.8%)
Missing	8 (3.7%)
Depression (EPDS)	
Mean (SD)	5.71 (4.71)
Missing	8 (3.7%)
Clinically significant symptoms	36 (17.3%)
State anxiety (STAI-SF)	
Mean (SD)	1.68 (0.59)
Missing	11 (5.1%)
Clinically significant symptoms	49 (23.9%)
Pregnancy-related anxiety	
Mean (SD)	1.65 (0.56)
Missing	10 (4.6%)
Communication levels with baby's MGM	
Talks once a week or more	171 (79.2%)
Talks less than once a week	29 (13.4%)
Missing	16 (7.4%)
Communication levels with baby's PGM	
Talks once a week or more	76 (35.2%)
Talks less than once a week	113 (52.3%)
Missing	27 (12.5%)
Communicationlevels with baby's father	
Talks once a week or more	189 (87.5%)
Talks less than once a week	17 (7.9%)
Missing	10 (4.6%)

Table 1 (*continued*)

	Total (N = 216)
Geographic proximity to baby's MGM	
Lives in the same home or neighborhood	120 (55.6%)
Lives in different neighborhood	74 (34.3%)
Missing	22 (10.2%)
Geographic proximity to baby's PGM	
Lives in the same home or neighborhood	74 (34.3%)
Lives in different neighborhood	114 (52.8%)
Missing	28 (13.0%)
Geographic proximity to baby's father	
Lives in the same home or neighborhood	184 (85.2%)
Lives in different neighborhood	17 (7.9%)
Missing	15 (6.9%)
Where does baby's MGM currently live?	
U.S.	134 (62.0%)
Mexico	48 (22.2%)
Another country	15 (6.9%)
Missing	19 (8.8%)
Where does baby's PGM currently live?	
U.S.	94 (43.5%)
Mexico	72 (33.3%)
Another country	23 (10.6%)
Missing	27 (12.5%)
Where does your baby's father currently live?	
U.S.	189 (87.5%)
Mexico	12 (5.6%)
Another country	5 (2.3%)
Missing	10 (4.6%)
Social support from baby's MGM	
Mean (SD)	2.65 (0.58)
Missing	15 (6.9%)
Social support from baby's PGM	
Mean (SD)	2.10 (0.78)
Missing	29 (13.4%)
Social support from baby's father	
Mean (SD)	2.71 (0.59)
Missing	9 (4.2%)

scale (α = 0.89 total, 0.89 English/0.90 Spanish). PRA score is the mean of items ranging from 1 to 4.

The multidimensional scale of perceived social support (MPSS) (Zimet, Dahlem, Zimet, & Farley, 1988; Zimet, Powell, Farley, Werkman, & Berkoff, 1990) is a 12-item measure of perceived adequacy of social support from three sources: family, friends, and significant other. The authors who developed the MPSS scale claim it measures an individuals' general perception of acceptable levels of social support from different sources. For this study, we adapted the four-item family subscale to refer specifically to the baby's grandmothers and father rather than family generally. These items use a three-point Likert rating on four statements (e.g., "*I get the emotional help and support I need from my mother*"), which was then averaged (Edwards, 2004). Our cohort had very high Cronbach alphas α = 0.94 (0.94 English/0.93 Spanish) for MGM, α = 0.94 (α = 0.95 English/ α = 0.94 Spanish) for PGM, and α = 0.97 (0.97 English/0.97 Spanish) for father. See Supplemental Table 4 for a breakdown of items in the scale, and a discussion of whether this general metric primarily reflects emotional or instrumental support. Due to (a) two items directly reflecting emotional support and (b) the two other ambiguous items not changing the mean scores when removed, we conclude that the scale is primarily a reflection of emotional support (SM).

Geographic proximity was captured by a single question: "*How nearby does [this person] live?*" operationalized as 'Close' (in the same home or neighborhood) or 'Not close' (outside or further than the same neighborhood) based on a median split of combined MGM and PGM geographic proximity. Communication was assessed by a single question: "*How often do you communicate with [this person]?*" operationalized as "A lot" (more than once a week) or "Not a lot" (once a week or less) based on a median split of combined MGM and PGM communication levels. See SM for further details of geographic proximity and communication variable operationalizations.

Socio-economic status (SES) was calculated as the sum of subjective SES, education, and food security (Fox, 2021) after each variable was rescaled from 0 to 1 such that higher values reflected higher SES.

2.3. Missingness, imputation, and regression diagnostics

Across all variables, 7% of observations were left blank (Fig. S1). We conducted multiple chain imputation with 20 iterations using the mice R package based on group-level relationships between variables to the end of five complete imputed datasets. Regression models were run on all imputed datasets and statistics were pooled. Breusch-Pagan tests rejected the null hypotheses of homoskedasticity in all depression and PRA models, but not state-anxiety models. To account for heteroskedasticity and remain conservative in our estimates, robust standard errors were calculated for all models. Further details regarding imputation, regression diagnostics, and sensitivity analysis are in SM.

2.4. Statistical models

Nine multiple linear regression models were run using R statistical software, v4.0.3, each with a mental health response variable and 10 predictor variables (two variables of interest reflecting features of the grandmother-mother relationship and eight control variables). These models were designed to isolate the particular contributions of each potential allomother on maternal mental health within a specific domain, while holding other demographic factors related to the pregnant woman's mental health constant, because geographic proximity, communication, and social support can overlap.

$$Y_i \; Maternal \; Psychology = \beta_0 + \beta_1 \, MGM + \beta_2 \, PGM + \beta_i \, Covariates + \varepsilon$$

For covariates, we included father relationship characteristics, maternal age, trimester, parity, foreign-born status and SES. We controlled for father relationship characteristics in order to eliminate the possibility that any effect of PGMs was just a proxy for father involvement. The characteristics were either his social support, geographic proximity, or communication depending on the model, which were each operationalized the same as the grandmother relationship characteristics. Age, parity, trimester, and SES were included because of the likelihood that each could be related to both allomaternal help received and prenatal mental health (Freeman et al., 2016; Glynn & Sandman, 2011). We controlled for foreign-born status because U.S.-born and foreign-born cohorts often have different social support networks and different rates of affective disorders and mental health resources available to them (Campos et al., 2008). We chose not to include relationship status, despite its previously-established influence on mental health, because of collinearity with father communication and geographic proximity, which were control variables with greater priority.

The outcome variables of interest were depression and anxiety, two of the most prominently studied psychological disorders during pregnancy that can have far-reaching consequences on infant outcome and offspring fitness. We measure anxiety two ways: state-anxiety, which captures the participants' current state of anxiety and pregnancy-related anxiety, which captures the participants' specific concerns of the development of her baby and labor. Having a general specific measure of anxiety seemed important to more deeply consider how grandmothers are influencing affect.

In each mental health model, we controlled for the other two mental health measures (e.g., in depression models, state anxiety and pregnancy-related anxiety were held constant). Due to the high comorbidity of depression and anxiety (Hirschfeld, 2001), it is important to include these controls in order to isolate the specific mental health variable in question. Variance-inflation factors (VIF) were calculated to examine correlations between independent variables to quantify multicollinearity. While some scholars suggest a VIF of 5 or 10 to be problematic (Menard, 2002), we use the more conservative 2.5 limit

(Johnston, Jones, & Manley, 2018). Variance-inflation factor calculations indicated no high levels of multicollinearity (VIF <2.1).

3. Results

The final analytic cohort of 216 pregnant women were 18–45 years old. A substantial portion of women were foreign-born (54%), food insecure (38%), nulliparous (33%), and had education equivalent to graduating high school (66%) or less (14%) (Table 1). Most women were in their third trimesters (61%) and in relationships (87%). Based on clinical cut-offs, women displayed rates of clinically significant depression (17%) and state anxiety (23%) symptoms (Table 1). These rates are similar to clinical depression and anxiety rates reported elsewhere among Latinas residing in the U.S., which are described as elevated in comparison to non-Hispanic White women (CDC, 2019; Ponting, Mahrer, Zelcer, Dunkel Schetter, & Chavira, 2020).

3.1. Social support

Perceived social support from MGMs was associated with lower rates of depression, while that from fathers and PGMs did not contribute significant effects (Table 2, Fig. S3). An increase along the social support scale from MGMs was associated with lower maternal depression (β: −1.25, robust SE: 0.44, p-value: 0.006), when all other variables were held constant. The pooled, unadjusted R^2 was 0.52 (CI: 0.52 to 0.62). The anxiety models were not significant for social support predictors of interest.

3.2. Geographic proximity

Neither MGMs' nor PGMs' geographic proximity was associated with mothers' mental health. While not the focus of this analysis, if the father did not live in the same neighborhood, the mother exhibited greater levels of PRA (Table 3, Fig. S4). When all other variables were held constant, the pooled β from the father living geographically near was associated with −0.36 in the mothers' PRA scores, SE: 0.17, p-value:0.047. The R^2 from the pooled model was 0.26 (CI: 0.26 to 0.39).

3.3. Communication

Communication with the MGM related to lower levels of depression, when all other variables were held constant (pooled β:-2.18, robust SE: 0.73, p-value: 0.004) (Table 4, Fig. S5). Communication with the father was significantly associated with less depression (pooled β: −1.87, robust SE: 0.9, p-value: 0.04). The unadjusted, pooled R^2 is 0.52 (CI: 0.52 to 0.61) for the depression model.

For the unpooled adjusted-R^2 of each model, run iteratively on each imputed dataset to penalize for number of covariates, see Tables S5–7.

We also ran analyses that removed deceased/unknown grandmothers and fathers from the cohort to investigate if there were differences when mothers had all potential allomothers available to them. This cohort did not differ in results. Communication and perceived social support were still statistically significant for maternal grandmothers only (and the father associations were also maintained with one additional finding emerging), see SM for regression results.

Table 2
The relationship of social support from maternal and paternal grandmother (row 2 and 3) on depression, state-anxiety, and pregnancy-related anxiety (columns 1–3, respectively), holding certain covariates constant (row 4–12). Each cell contains the pooled beta, with stars indicating significance level and pooled robust standard errors in the parentheses. R^2, the pooled coefficient of determination, indicatesing how much variation in mental health is explained by the predictor and control variables. N, or total women in the study, is also presented.

	Depression	State Anxiety	Pregnancy-Related Anxiety
Intercept	2.77	1.20***	1.08**
	(2.62)	(0.31)	(0.37)
Social Support - Maternal Grandmother	−1.25**	0.02	−0.01
	(0.44)	(0.06)	(0.07)
Social Support - Paternal Grandmother	−0.26	−0.01	0.05
	(0.32)	(0.04)	(0.06)
Social Support - Father	−0.88	−0.03	0.02
	(0.46)	(0.06)	(0.07)
Socio-Economic Status	−0.55	−0.04	−0.15*
	(0.41)	(0.06)	(0.07)
Foreign Born	0.52	−0.14*	0.02
	(0.50)	(0.07)	(0.07)
Age	−0.00	0.00	0.01*
	(0.05)	(0.01)	(0.01)
Trimester	0.34	−0.02	−0.08
	(0.43)	(0.05)	(0.06)
Parity	−0.23	0.01	−0.04
	(0.21)	(0.03)	(0.03)
State Anxiety	4.40***		0.19*
	(0.48)		(0.09)
Pregnancy-Related Anxiety	1.05*	0.14*	
	(0.51)	(0.06)	
Depression		0.07***	0.02*
		(0.01)	(0.01)
R^2	0.52	0.48	0.23
N	216	216	216

p < 0.001 ***; p < 0.01**; p < 0.05*.
Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (F-statistics; p-values): depression (18.85;<0.0001), state anxiety (16.38;<0.0001), pregnancy-related anxiety (4.82;<0.0001).

Table 3
The relationship of geographic proximity from maternal grandmother and paternal grandmother (row 2 and 3) on depression, state-anxiety, and pregnancy related anxiety (columns 1–3, respectively), holding certain covariates constant (row 4–12). Each cell contains the pooled beta, with stars indicating significance level and pooled robust standard errors in the parentheses. R^2 and N are also presented.

	Depression	State Anxiety	Pregnancy-Related Anxiety
Intercept	−5.21*	0.98***	1.55***
	(2.15)	(0.26)	(0.30)
Geographic Proximity - Maternal Grandmother	−0.31	0.08	−0.02
	(0.55)	(0.07)	(0.08)
Geographic Proximity - Paternal Grandmother	0.64	−0.00	−0.04
	(0.63)	(0.08)	(0.08)
Geographic Proximity - Father	0.47	0.09	−0.36*
	(0.98)	(0.11)	(0.17)
Socio-Economic Status	−0.58	−0.05	−0.15*
	(0.44)	(0.06)	(0.07)
Foreign Born	0.59	−0.11	0.00
	(0.56)	(0.07)	(0.08)
Age	0.02	0.00	0.01
	(0.05)	(0.01)	(0.01)
Trimester	0.24	−0.02	−0.07
	(0.43)	(0.05)	(0.06)
Parity	−0.21	0.01	−0.04
	(0.23)	(0.03)	(0.03)
State Anxiety	4.79***		0.20*
	(0.46)		(0.09)
Pregnancy-Related Anxiety	1.15*	0.15*	
	(0.53)	(0.07)	
Depression		0.07***	0.02*
		(0.01)	(0.01)
R^2	0.48	0.48	0.26
N	216	216	216

p < 0.001***; p < 0.01**; p < 0.05*.
Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (F-statistics; p-values): depression (15.92;<0.0001), state anxiety (16.19;<0.0001), pregnancy-related anxiety (5.59;<0.0001).

Table 4
The relationship of communication from maternal and paternal grandmother (rows 2 and 3) on depression, state-anxiety, and pregnancy related anxiety (columns 1–3, respectively), holding certain covariates constant (rows 4–12). Each cell contains the pooled beta, with stars indicating significance level and pooled robust standard errors in the parentheses. R^2 and N are also presented.

	Depression	State Anxiety	Pregnancy-Related Anxiety
Intercept	−0.68	1.05***	1.00**
	(2.14)	(0.26)	(0.32)
Communication - Maternal Grandmother	−2.18**	0.12	0.07
	(0.73)	(0.09)	(0.10)
Communication - Paternal Grandmother	0.16	−0.07	−0.09
	(0.55)	(0.07)	(0.09)
Communication - Father	−1.87*	0.03	0.23
	(0.90)	(0.13)	(0.13)
Socio-Economic Status	−0.58	−0.05	−0.14*
	(0.42)	(0.06)	(0.07)
Foreign Born	0.49	−0.14*	0.00
	(0.51)	(0.06)	(0.08)
Age	−0.01	0.00	0.01*
	(0.05)	(0.01)	(0.01)
Trimester	0.42	−0.02	−0.09
	(0.44)	(0.05)	(0.06)
Parity	−0.19	0.01	−0.04
	(0.21)	(0.03)	(0.03)
State Anxiety	4.66***		0.17
	(0.47)		(0.09)
Pregnancy-Related Anxiety	1.19*	0.13*	
	(0.51)	(0.06)	
Depression		0.08***	0.03*
		(0.01)	(0.01)
R^2	0.52	0.49	0.24
N	216	216	216

p < 0.001***; p < 0.01**; p < 0.05*.

Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (F-statistics; p-values): depression (18.23;<0.0001), state anxiety (14.04;<0.0001), pregnancy-related anxiety (6.72;<0.0001).

4. Discussion

We expected to observe positive associations of MGM social support, geographic proximity, and communication with maternal mental health, and positive or neutral PGM associations under the assumption that both these allomothers would be interested in improving maternal mental health for the benefit of the developing offspring. Our results were significant for MGMs in certain domains and not PGMs. Specifically, greater communication with and social support from MGM was associated with lower depression among mothers. Because our instrument of social support contained questions mostly related to emotional support, our results suggest that MGMs play an important role in a mother's prenatal psychology through emotional support. Additionally, our results suggest that geographic proximity is not required for emotional support to be transmitted. There also appears to be greater allomother association with maternal depression than to maternal anxiety.

Theoretically, both MGMs and PGMs should be equally related to offspring ($r = 0.25$) and unequally related to the mother ($r = 0.5$ and $r = 0.0$). Thus, both grandmothers should invest equally in offspring to maximize inclusive fitness benefits, but unequally in the mother due to differences in direct fitness (Perry & Daly, 2017). Each grandmother may act as both a MGM and a PGM through her daughters and sons, respectively (Chapman, Lahdenperä, Pettay, Lynch, & Lummaa, 2021), but given the finite resource of her time, trade-offs will be made. Under a DOHaD framework, both grandmothers should be aligned during the prenatal period to invest in the mother for the benefits to the developing offspring. Instead, we see a difference in maternal and paternal

grandmother prenatal investment. Paternity uncertainty may play a role as it suggests that investments through the paternal line are riskier (Trivers, 1972). However, cross-cultural evidence does not suggest paternity uncertainty to be a major factor of allomother investments (Anderson, 2006; Pashos, 2017; Prall & Scelza, 2020). For example, within populations of assumed low rates of paternity uncertainty – such as Orthodox Jewish populations – grandparental investment is still different for the maternal and paternal lines, suggesting other factors are involved (McBurney, Simon, Gaulin, & Geliebter, 2002). One such explanation could be the long-term relationships of MGM with mothers compared to PGM with mothers. Another evolutionary explanation of different grandparental investments during pregnancy is maternal-fetal conflict. While fitness interests of the mother and developing fetus mostly overlap, they do not perfectly align (Haig, 2015). Most energy supports the fetus, but some may be reserved for future offspring. Therefore, it is likely always more beneficial for MGM to invest in pregnancy than PGM given that the father may change in the next pregnancy.

Our results add to the growing evidence that geographic proximity itself is not always a critical component of grandmaternal allomothering. For example, in a market-integrated Puerto Rican cohort, infant survival was positively associated with MGM geographic proximity when she was also listed as a primary donor of social support (Scelza, 2011). However, if MGMs were close-by and not listed as a primary donor, there was an increase in the odds-ratio of infant death and low birth-weight (Scelza, 2011). These lines of evidence describe how geographic proximity is not the whole story, but instead may be a moderating variable. Among positive relationships it may act as a proxy for instrumental social support, but among strained relationships geographic proximity may worsen experiences due to other tensions in the relationship.

We found that geographic proximity to the father was significantly associated with less PRA. Communication with the father was significantly associated with lower levels of depression. What mothers need from fathers may be different from what they need from other family members, and further work should explore these differences. Additionally, our study contributes to the idea that broader support networks, beyond the baby's father, can be critical for maternal well-being.

4.1. Cultural explanations

Culture and biological evolution are enmeshed in many ways. Certain cultural values and practices may derive from aspects of cognition and/or physiology shaped by evolutionary processes, and culture itself can reflect evolutionary processes such as drift and selection. Not all cultural attributes are adaptive or directly related to our biology. Therefore, it is necessary to consider the possibility that patterns detected in our data analyses may derive from aspects of culture that are only minimally attributable to evolutionary processes.

Familismo predicts a greater involvement of family, and patriarchal values and patrilocality would predict greater involvement of PGM. These values are common in much of Latin America, including many parts of Mexico where the majority of women in this cohort have their heritage. This cultural context would predict a high degree of PGM involvement and therefore an association – in either direction – of PGM relationship characteristics with maternal mental health; however, our PGM models yielded null results. This observation supports the evolutionary framing that PGMs are not as evolutionarily motivated to assist their daughters-in-law, despite potential DOHaD-related benefits.

4.2. Mental health in an evolutionary context

When considering how grandmothers influence maternal mental health in an evolutionary context, we should consider the evolutionary function of mood and emotions. Anxiety and depression are cast in the evolutionary psychology framework as adaptive in certain ecological

contexts; however, the modern post-industrial environment may be mismatched to the adaptive value of emotions that developed in response to different ecologies.

Anxiety, for example, is described as exhibiting a lower reactivity threshold in response to threat (Bateson, Brilot, & Nettle, 2011; Nettle & Bateson, 2012). Anxiety can be a helpful response in an uncertain environment. Depression, in contrast, is framed by Nettle and Bateson as a higher reactivity threshold to the possibility of reward (2012). Depression may serve an adaptive function to encourage individuals to stop pursuing tasks that are not worth time and energy. Depression therefore may be part of normal human variation in response to unsuccessful tasks, but maladaptive if continually present (Nesse, 2019).

Others have framed postpartum depression (PPD) as a way of eliciting support from others by going 'on strike' (Hagen, 2002). If help is needed prenatally, this framing could be extended into prenatal depression. However, Hagen uses only observational evidence of low social support leading to PPD to corroborate the theory that PPD is an adaptive signal to elicit more social support. The association of social support and depression in our results could similarly support Hagen's 'going on strike' hypothesis. We argue that our results could just as easily be explained through a positive feedback loop, where certain individuals may be more prone to depression and a lack of communication or social support reinforces these feelings. Indeed, other work on the adaptation of postpartum depression found that women experiencing PPD during their first pregnancy had overall lower future fertility than those without PPD at first pregnancy (Myers, Burger, & Johns, 2016), suggesting PPD is not adaptive.

In regards to anxiety, our results support the idea that individuals who feel more reactive to threat or are experiencing more threat might choose to live closer to family, explaining our observation that geographic proximity was associated with lower PRA. Conversely, it is possible that less geographic proximity to family reflects a more dangerous experience, especially in the context of pregnancy. If the father is distant, it might generate feelings in the mother to be more vigilant about her pregnancy or that if something went wrong with the pregnancy, the mother would have less support to deal with it. The PRA scale includes both concerns over how the baby is developing and labor and delivery. One might expect that MGMs would serve as the most important figures during a birth due to prior experience, but in a context of professional medical care, geographic proximity to the father may be most important in reducing PRA due to emotional, financial, or logistical support.

5. Conclusions

This study explores whether grandmother relationship characteristics are associated with prenatal mental health, motivated by the premise that positive associations are beneficial to the success of the pregnancy. Here, we suggest that grandmaternal allomothering includes the prenatal period. We observe that social support and communication with MGMs, but not PGMs, are associated with mental health benefits for mothers. More work is needed to connect this prenatal grandmaternal influence to offspring postnatal outcomes.

5.1. Public health implications

Within our cohort, quite a few family members live on different sides of a border than the mother (63 MGMs, 95 PGMs, and 17 fathers; Table 1). We observe positive relationships for both MGM and father communication with maternal mental health, even when a number of these individuals lived across borders. Above and beyond foreign-born status, we find that family had a positive influence through communication, which is uncoupled from geographic proximity in our survey design. This finding suggests some feasible implications for public health. Funding call minutes, phones, and internet infrastructure to increase a family's ability to stay in contact with each other when living

distantly or when visitation is not possible could positively contribute to perinatal mental health. For example, during the COVID-19 pandemic there were significant decreases in preterm births associated with government-imposed lock down (Berghella, Boelig, Roman, Burd, & Anderson, 2020). This trend can be explained speculatively by spending more time with family. Maintaining channels of communication is especially important during the prenatal experience and for families that are separated geographically. The context of family separation due to immigration restrictions, which remain important today, were especially salient at the time of data collection (2016–2018).

This work supports a broader anthropological discussion that the "nuclear family" is not better or best. There is a large literature on the negative impacts of father absences; however, it does not always indicate that his influence cannot be replaced by someone else in the allomaternal network (Sear, 2016, 2021). Government policies should support more flexible family networks beyond the nuclear family. Additionally, exploring more kin-categories may improve our understanding of the pooled allomaternal network on mental health.

5.2. Limitations and future directions

Without offspring outcomes, we are limited in our ability to claim a fitness benefit. We also cannot discern causality because of the use of observational data with a cross-sectional study design. The statistical method of regression does not describe the direction of the association, so it could be true that grandmother communication with the mother and social support to the mother during pregnancy decreases depression, or, less depression during pregnancy increases grandmother-mother communication and perceived social support. It is also possible that an unmeasured third variable causes both effects. Longitudinal data in future studies will help to answer questions of causality. Additionally, our study could have been improved by knowing depression diagnoses prior to pregnancy, as this is a major risk-factor for perinatal depression (Kee et al., 2021); however, this was not included in our data. We also acknowledge a diversity within our cohort beyond what is captured by the term "Latina", including regional and socio-cultural differences. We make no claim to generalize results to other cohorts.

The experience of long-term family bonds may account for the stronger association of MGM over PGM relationship characteristics with maternal mental health. The null results of the PGM in our analyses may also be due to a smaller effect than MGM's influence that we are underpowered to measure. Future studies with larger sample sizes will help determine if there is indeed an absence of a PGM prenatal effect or if it is just a smaller effect than MGM. Additionally, we lack relevant information about how many grandchildren each grandmother has already and with whom she spends most of her time. Each grandmother is either a maternal or paternal grandmother for the mothers in our study, but may act as the other type of grandmother for other mothers. She may have different evolutionary incentives for different mothers and grandchildren in her family. Future studies should compare a focal grandmother's effect on both her own daughters and daughters-in-law to gauge how competing potential investment opportunities influence grandmother prenatal investment decisions similar to postnatal studies of focal grandmothers (Chapman et al., 2021). In our cohort, women are mostly certain of who the biological father is and it was most often the current relationship partner (Table 1). It is unknown to us how confident the fathers and paternal grandmothers in this study are about the paternity of the baby.

Future work could evaluate why certain social experiences are associated more with prenatal depression than anxiety. Studies could also explore grandmaternal influence using qualitative methods to create a deeper understanding of these experiences. By including measures of grandmaternal instrumental support and infant outcomes, future work could also further our understanding of grandmaternal involvement in the context of fetal programming.

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Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi. org/10.1016/j.evolhumbehav.2022.10.005.

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Appendix B: Supplementary Materials for Chapter 3

B.1. Methods

B.1.1 Operationalization of variables - Mental Health

Perinatal depression was measured by the Edinburgh perinatal depression scale (EPDS).

As it says in the manuscript, each item was ranked on a 1-4 scale with phrases like "*No, never*"

and "*Yes, most of the time.*" See Supplemental Table S1 for the item breakdown for this scale.

Supplemental Table S1: Item Breakdown of EPDS Scale

Reverse Coded	EPDS Scale Item Text	
	English	**Spanish**
	I have been able to laugh and see the funny side of things	He podido reír y ver el lado gracioso de las cosas
	I have looked forward with enjoyment to things	He mirado al futuro con placer para hacer cosas
x	I have blamed myself unnecessarily when things went wrong	Me he culpado sin necesidad cuando las cosas marchaban mal
	I have been anxious or worried for no good reason	He estado ansiosa y preocupada sin motivo
x	I have felt scared or panicky for no very good reason	He sentido miedo o pánico sin motivo alguno
x	Things have been getting on top of me	Las cosas me oprimen o agobian
x	I have been so unhappy that I have had difficulty sleeping	Me he sentido tan infeliz, que he tenido dificultad para dormir
x	I have felt sad or miserable	Me he sentido triste y desgraciada
x	I have been so unhappy that I have been crying	Me he sentido tan infeliz que he estado llorando
x	The thought of harming myself has occurred to me	He pensado en hacerme daño

State anxiety was measured with the state trait anxiety inventory short form (STAI-SF). A

validation study found no statistically significant differences between the 6-item short-form

prorated pregnant women's scores and the full-length scale (Marteau & Bekker, 1992). This also

used a 1-4 rating of each item with phrases "*Not at all*" to "*Very much.*" See Supplemental Table

S2 for the item breakdown for this scale.

Supplemental Table S2: Item Breakdown of STAI-SF Scale

Reverse Coded	STAI-SF Item Text	
	English	**Spanish**
x	I feel calm	Me siento calmada
	I feel upset	Me siento disgustada
x	I feel content	Me siento contenta
x	I am relaxed	Estoy relajada
	I am worried	Estoy preocupada
	I am tense	Estoy tensa

Pregnancy-related anxiety was measured with scores 1-4, such as "*Not at all*" to "*Very much.*"

Supplemental Table S3: Item Breakdown of PRA Scale

Reverse Coded	Pregnancy-Related Anxiety Scale Item Text	
	English	**Spanish**
X	I am confident about having a normal childbirth.	Estoy segura de tener un parto normal.
X	I think my labor and delivery will go normally.	Creo que mi parto irá normalmente.
	I am fearful regarding the health of my baby.	Temo por la salud de mi bebé.
	I am worried that the baby might not be normal.	Me preocupa que el bebé no sea normal.
	I am afraid that I will be harmed during delivery.	Temo que voy a sufrir daños durante el parto.
	I am concerned or worried about how the baby is growing and developing inside me.	Estoy preocupada acerca de cómo el bebé está creciendo y desarrollándose dentro de mí.
	I am concerned or worried about losing the baby.	Estoy preocupada de perder él bebé.
	I am concerned or worried about having a hard or difficult labor and delivery.	Me preocupa o temo de tener un parto duro o difícil.
	I am concerned or worried about taking care of a new baby.	Me preocupa o temo de cuidar a un bebé recién nacido.
	I am concerned or worried about developing medical problems during the pregnancy.	Me preocupa o temo que desarrolle problemas médicos durante el embarazo.

B.1.2 Operationalization of variables - Allomother-mother Relationship Characteristics

Social support was measured with the Multidimensional Scale of Perceived Social Support

(MPSS) scale, where each item was score 1-3 with "*Not true*", "*Somewhat true*", "*Very true.*"

Supplemental Table S4: Item Breakdown of MPSS Scale

MPSS Scale Item Text	
English	**Spanish**
My mother really tries to help me.	Mi madre realmente me trata de ayudar.
I get the emotional help and support I need from my mother.	Yo recibo el apoyo y ayuda emocional que necesito de mi madre.
I can talk about my problems with my mother.	Puedo hablar de mis problemas con mi madre.
My mother. is willing to help me make decisions.	Mi madre dispuesta a ayudarme a tomar decisiones.

We asked this scale for baby's father, maternal grandmother, and paternal grandmother. For maternal grandmother, we used the term "mother" and for paternal grandmother we used "baby's father's mother."

Since emotional and instrumental social support have been shown to impact perinatal outcomes differently (Bedaso et al., 2021; Emmott & Mace, 2015), we ask if this validated, but generically named scale, primarily reflects emotional or instrumental support. Items 2 and 3 of the MPSS strongly reflect emotional support. We explored the data by removing items 1 and 4 from this scale. With just the emotional support items, we found that the mean MPSS score only slightly changed for approximately 2.8% of the cohort's MGM score and 2.3% of the cohort's PGM score. Therefore, we determined it was not likely to change the broader regression results. Additionally, the strong reliability and high Cronbach alphas suggests that items 1 and 4 are not adding noise to the emotional support questions. Therefore, we state that the MPSS scale overall reflects emotional support most strongly of the different forms of social support that can influence perinatal outcomes.

Geographic proximity was one question, "*How nearby does [this person] live*?", with response options 1 = *In my home*, 2 = *In my neighborhood*, 3 = *Outside my neighborhood but close enough to visit during the day*, 4 = *Too far to visit during the day*. We reverse-coded this variable

so greater numerical values were associated with greater levels of geographic proximity. We then operationalized the variable as 'Close' (in the same home or neighborhood) or 'Not Close' (outside or further than the same neighborhood) based on a median split of combined MGM and PGM geographic proximity.

Communication was assessed by a single question: "*How often do you communicate with [this person]*?" with response options 1 = *Every day*, 2 = *More than once a week*, 3 = *More than once a month*, 4 = *Once a month or less*, 5 = *Never*. We reverse-coded and operationalized as "A lot" (more than once a week) or "Not a lot" (less than once a week) based on a median split of combined MGM and PGM communication levels.

B.1.3 Mental Health Thresholds

The clinically significant cut-off thresholds presented in this chapter were only included in Table 1 to help describe the cohort; these thresholds were calculated the following ways. For the Edinburgh Perinatal Depression Scale (EPDS) (Cox et al., 1987, 1996; Santos et al., 2007), scores were calculated based on a summation of individual items. These summary scores can range from 0-30. Scores greater than 10 were identified as likely for at least minor depression. While there is some debate over the proper cut-off score to use, a validation of the EPDS among Spanish-speaking women suggests a cut-off threshold of 10 or 11 (Garcia Esteve et al., 2003). For anxiety, we use the short form state-trait anxiety inventory (STAI-SF), which is a 6-item scale based on the full-length 20-item STAI. The full-length scale scores participant answers with a range of 20-80, and describes scores ≥ 40 as likely to have clinical anxiety (Julian, 2011). We use a mean score with STAI-SF and extrapolate their methods to describe scores of 2 or greater as associated with clinical levels of anxiety (equivalent to a sum score of >12). The same cut-off has been used elsewhere (Micallef et al., 1998).

B.1.4 Missingness

We examined missingness through the Amelia package in R. Overall, 7% of the observations were left blank (Figure S1). Individual variables ranged in missing from 1.4% (foreign-born) to 12.0% (food insecurity).

Supplemental Figure S1: Overall Missingness of Cohort Survey Responses

Missingness map of pregnant only cohort

Missing (7%)
Observed (93%)

B.1.5 Imputation

Multiple chain imputation was conducted on the 216 individuals using additional variables not in the main analysis to improve accuracy of imputations (i.e., measure of general family support, measures of how often the participant saw each individual in person). Subject IDs were not included in imputation. We conducted 20 iterations of imputation for each of the five imputed datasets using the MICE package in R.

Density plots were used to determine if imputation was within range for all variables and if the distributions of each variable was maintained across imputed datasets (Figure S2).

Supplemental Figure S2: Density Diagnostic Plot of Imputed Variables
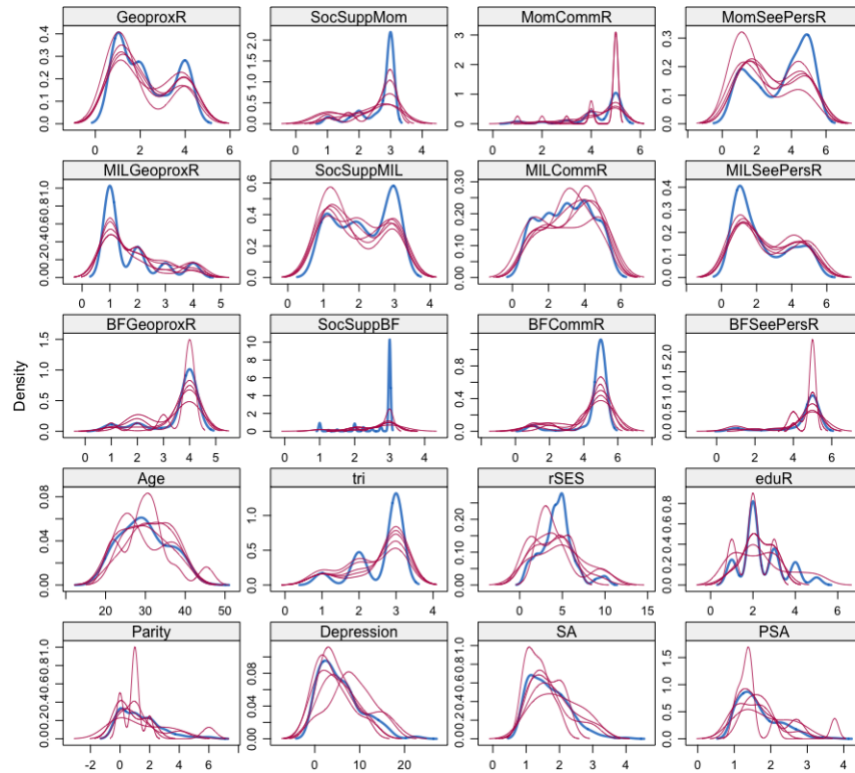
Supplemental Figure S2 Caption: Imputed data was calculated with multiple chain imputation with the MICE package in R. The red lines indicate the distribution of imputed variables, while blue lines are the distribution of the original data.

B.1.6 Sensitivity Analysis

With Power Analysis Software G*Power, we conducted a sensitivity power analysis in the F test family, and determined that with an 80% power and a sample size of 216, we are able to detect an effect size of $f^2 = .08$. When translated to Cohen's d, we get 0.56, which is a medium effect size (Cohen, 1988).

B.1.7 Regression Diagnostics

The following supplemental tables (Table S5-7) describe relevant regression diagnostics for each of the models run on each of the imputed datasets. Data was pooled for presentation in

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this chapter, but is presented individually here. Column 1 names the model. Column 2 describes the maximum variance inflation factor (VIF) for the model. The VIF measures whether there is high-levels of multicollinearity. Variance-inflation factors (VIF) were calculated to examine correlations between independent variables to quantify multi-collinearity. While some scholars suggest a VIF of 5 or 10 to be problematic (Menard, 2002), we use the more conservative 2.5 limit (Johnston et al., 2018; Craney & Surles, 2002). Some debate has circled around these cut-offs and their usefulness, but our results show that the VIF is consistently low indicating that multicollinearity is not a concern in our models. Column 3 presents the p-value results from the Breusch-Pagan test which looks for heteroskedasticity. All state anxiety models and some pregnancy-anxiety models failed to reject the null hypothesis of heteroskedasticity. To account for heteroskedasticity and remain conservative in our estimates, robust standard errors were calculated for all models. Column 4 is the adjusted R^2 for each model, which was calculated in order to describe how much variance of the outcome variable is associated with the predictors, including a penalty to account for the number of predictor variables. Residual plots run iteratively on each model for each imputed dataset did not reveal anything out of the ordinary (e.g., no non-linear relationships, high leverage data points).

Supplemental Table S5:

Regression Diagnostics for Social Support Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation Model #1	1.32	0.001	0.51
Depression Imputation Model #2	1.32	0.003	0.53
Depression Imputation Model #3	1.28	0.002	0.46
Depression Imputation Model #4	1.32	0.000	0.48

Regression Diagnostics for Social Support Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation Model #5	1.32	0.001	0.49
State Anxiety Imputation Model #1	1.41	0.484	0.47
State Anxiety Imputation Model #2	1.46	0.411	0.45
State Anxiety Imputation Model #3	1.32	0.669	0.44
State Anxiety Imputation Model #4	1.39	0.377	0.43
State Anxiety Imputation Model #5	1.41	0.669	0.43
Pregnancy-Related Anxiety Imputation Model #1	2.05	0.015	0.20
Pregnancy-Related Anxiety Imputation Model #2	2.11	0.003	0.23
Pregnancy-Related Anxiety Imputation Model #3	1.9	0.177	0.19
Pregnancy-Related Anxiety Imputation Model #4	1.93	0.093	0.20
Pregnancy-Related Anxiety Imputation Model #5	2.01	0.07	0.15

Supplemental Table S6:

Regression Diagnostics for Geographic Proximity Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation Model #1	1.51	0.001	0.48
Depression Imputation Model #2	1.51	0.000	0.47
Depression Imputation Model #3	1.52	0.001	0.44
Depression Imputation Model #4	1.48	0.001	0.44
Depression Imputation Model #5	1.53	0.001	0.46

Regression Diagnostics for Geographic Proximity Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
State Anxiety Imputation Model #1	1.51	0.897	0.48
State Anxiety Imputation Model #2	1.50	0.776	0.46
State Anxiety Imputation Model #3	1.52	0.894	0.46
State Anxiety Imputation Model #4	1.48	0.635	0.45
State Anxiety Imputation Model #5	1.54	0.954	0.45
Pregnancy-Related Anxiety Imputation Model #1	1.95	0.036	0.21
Pregnancy-Related Anxiety Imputation Model #2	1.91	0.123	0.26
Pregnancy-Related Anxiety Imputation Model #3	1.86	0.017	0.27
Pregnancy-Related Anxiety Imputation Model #4	1.85	0.037	0.22
Pregnancy-Related Anxiety Imputation Model #5	1.90	0.039	0.17

Supplemental Table S7:

Regression Diagnostics for Communication Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation Model #1	1.45	0.007	0.51
Depression Imputation Model #2	1.44	0.008	0.52
Depression Imputation Model #3	1.45	0.001	0.47
Depression Imputation Model #4	1.44	0.001	0.47
Depression Imputation Model #5	1.46	0.003	0.49
State Anxiety Imputation Model #1	1.45	0.965	0.48

Regression Diagnostics for Communication Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
State Anxiety Imputation Model #2	1.44	0.767	0.46
State Anxiety Imputation Model #3	1.45	0.883	0.47
State Anxiety Imputation Model #4	1.44	0.683	0.45
State Anxiety Imputation Model #5	1.46	0.950	0.45
Pregnancy-Related Anxiety Imputation Model #1	2.06	0.169	0.19
Pregnancy-Related Anxiety Imputation Model #2	2.08	0.133	0.24
Pregnancy-Related Anxiety Imputation Model #3	1.93	0.158	0.21
Pregnancy-Related Anxiety Imputation Model #4	1.93	0.234	0.22
Pregnancy-Related Anxiety Imputation Model #5	2.00	0.142	0.16

B.2 Results Graphs of Models

Each supplementary figure below visualizes the models presented in their respective tables, with Figure S3 representing the models presented in Table 2 (Social Support) with Figure S3a representing column 1 (Depression, EPDS), Figure S3b representing column 2 (State-Anxiety, STAI-SF), and Figure S3c representing column 3 (Pregnancy-Related Anxiety, PRA). The subparts (a, b, and c) are the same for Figure S3-5. Figure S4 representing Table 3 (Geographic Proximity), and Figure S5 representing Table 4 (Communication). Each figure shows the distribution of association with each of the 5 imputed models, each represented by a different color. The distribution of each imputed model tends to overlap indicating consistency across out imputed datasets.

Supplemental Figure S3: Social Support Models

Figure S3a: Depression
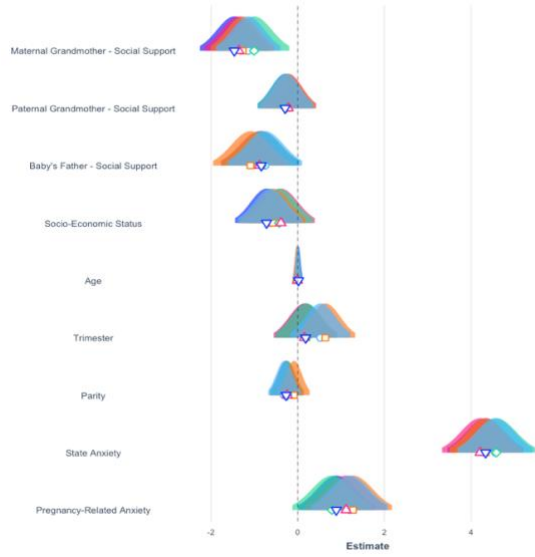
Figure S3b: State-Anxiety
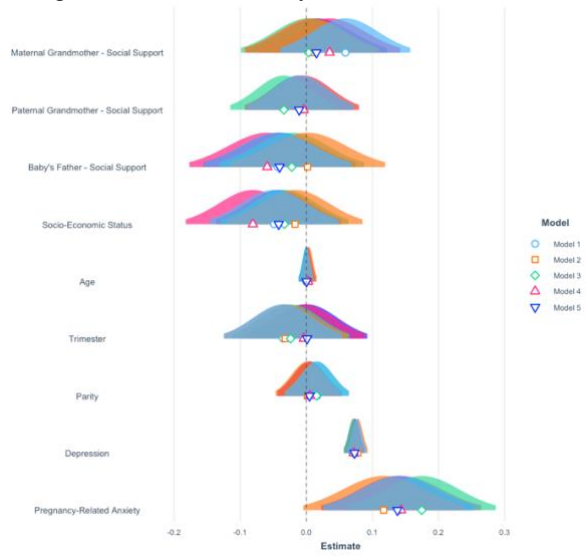
Figure S3c: Pregnancy-Related Anxiety
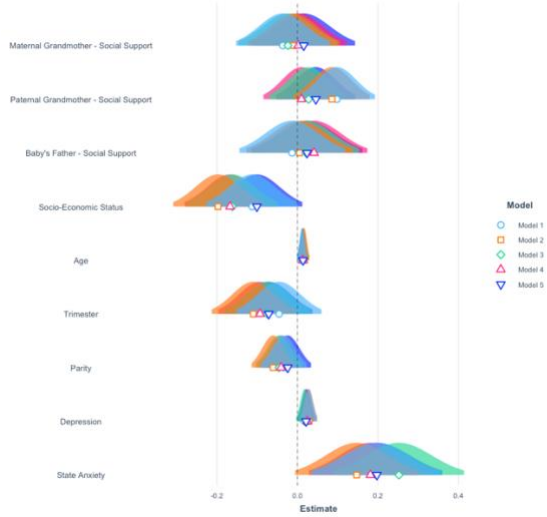
Supplemental Figure S4: Geographic Proximity Models

Figure S4a: Depression
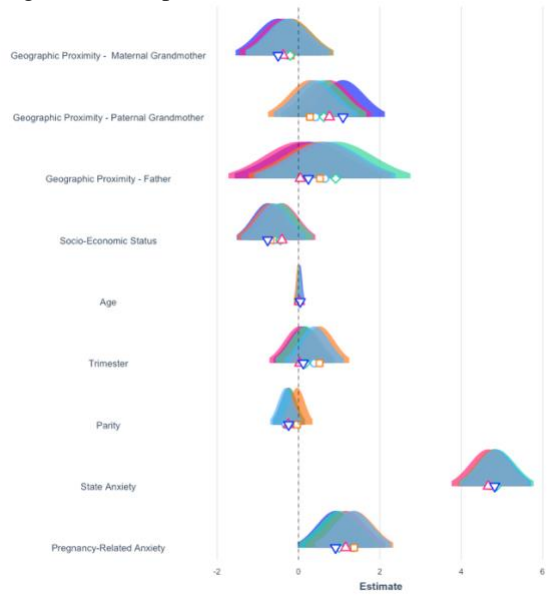
Figure S4b: State-Anxiety
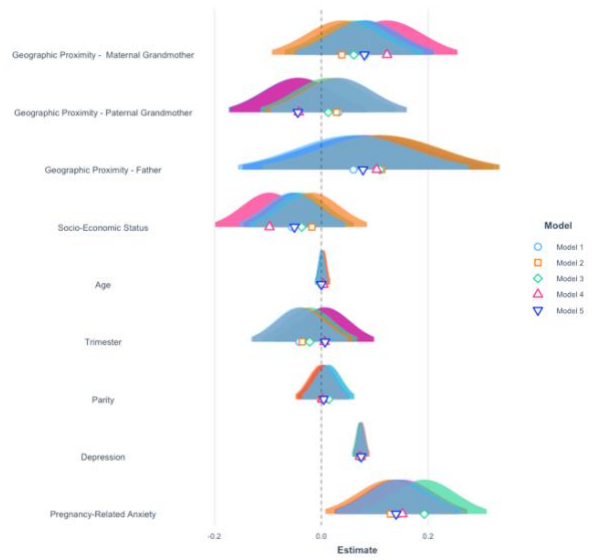
Figure S4c: Pregnancy-Related Anxiety
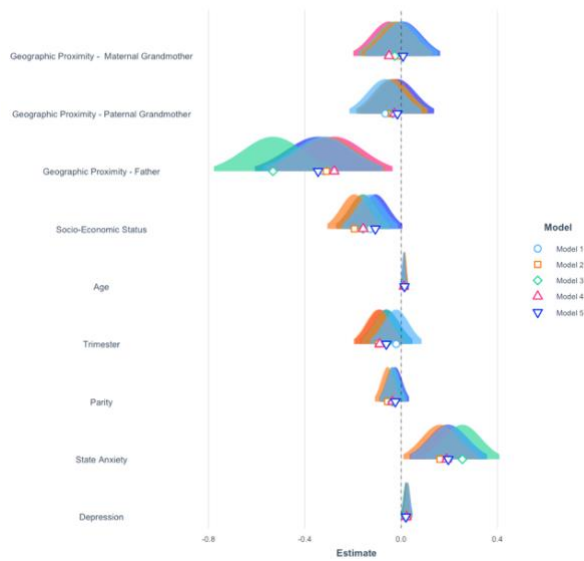
Supplemental Figure S5: Communication Models

Figure S5a: Depression
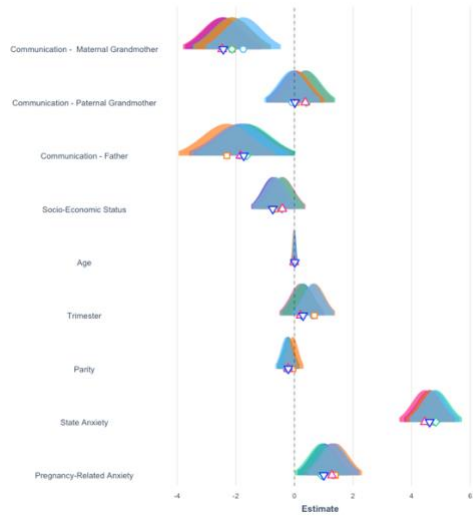
Figure S5b: State-Anxiety
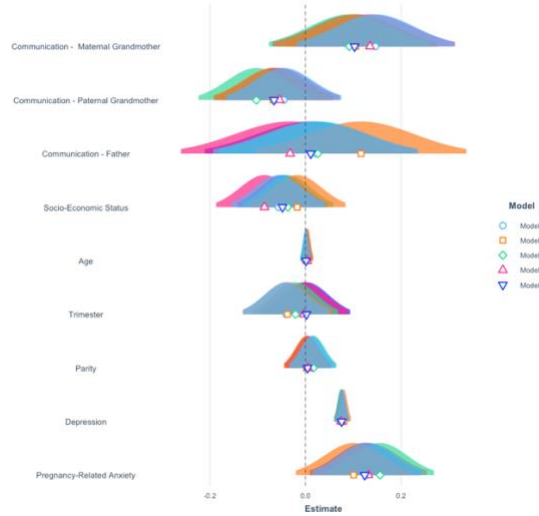
Figure S5c: Pregnancy-Related Anxiety
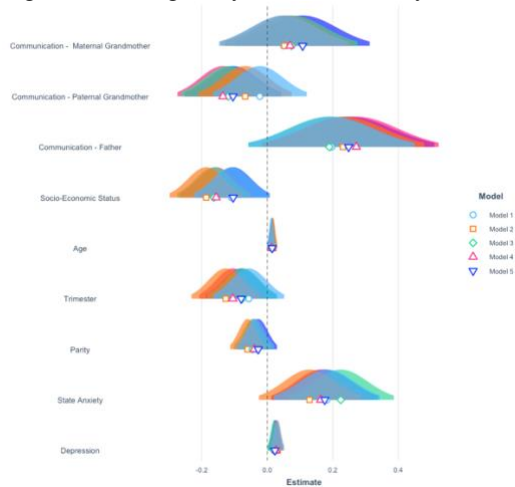
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Chapter 4: Maternal Grandmothers Buffer the Effects of Ethnic Discrimination Among Pregnant Latina Mothers

RESEARCH ARTICLE

Maternal grandmothers buffer the effects of ethnic discrimination among pregnant Latina mothers

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Abstract

Ethnic discrimination during pregnancy is linked to maternal psychological distress, adverse birth outcomes and increased offspring morbidity and mortality. An evolutionary perspective reframes offspring health issues as a risk to maternal fitness. We argue that kin may be evolutionarily motivated to buffer psychosocial stressors for the mother during pregnancy. Previously, we found that the relationship of a pregnant woman with her own mother (fetus' maternal grandmother) had a positive association on maternal prenatal psychology, above and beyond her relationship with her fetus' father. Here, we ask if grandmothers buffer mothers' prenatal psychological distress from ethnic discrimination. Using self-report data collected from 216 pregnant Latina women living in Southern California, we found discrimination to be significantly, positively associated with depression, anxiety, and stress in linear regression models. Maternal grandmother communication attenuated the association of discrimination and all three psychological distress measures, adjusting for the mother's relationship with the father. Maternal grandmother emotional support similarly significantly moderated the relationship of discrimination with depression and anxiety. We did not observe any significant interactions for paternal grandmother relationships. Geographic proximity was not a significant stress buffer. Results suggest the important role maternal grandmothers play in perinatal mental health, and that these benefits exist uncoupled from geographic proximity.

Keywords: allomothers; grandmothers; discrimination; emotional support; prenatal psychological distress

Social media summary: Grandmother–mother relationships buffer against ill-effects of ethnic discrimination on prenatal psychological distress.

1. Introduction

The framework of developmental origins of health and disease, DOHaD, describes how mothers' prenatal environmental exposures (including psychosocial stressors) can create long-term phenotypic changes in offspring that lead to elevated disease risk across the life course (Gluckman et al., 2008). When pregnant women experience psychosocial stressors, perturbations to fetal development, birth timing and infant development can occur. Prenatal maternal psychological distress (including stress, anxiety, and depression) has also been associated with low-birth weight and preterm birth (Grigoriadis et al., 2013, 2018; Grote et al., 2010), which in turn are associated with the offspring's long-term disease-risk, including cardiovascular disease, obesity, diabetes and psychopathology (Callaghan et al., 2006; Eshete et al., 2019).
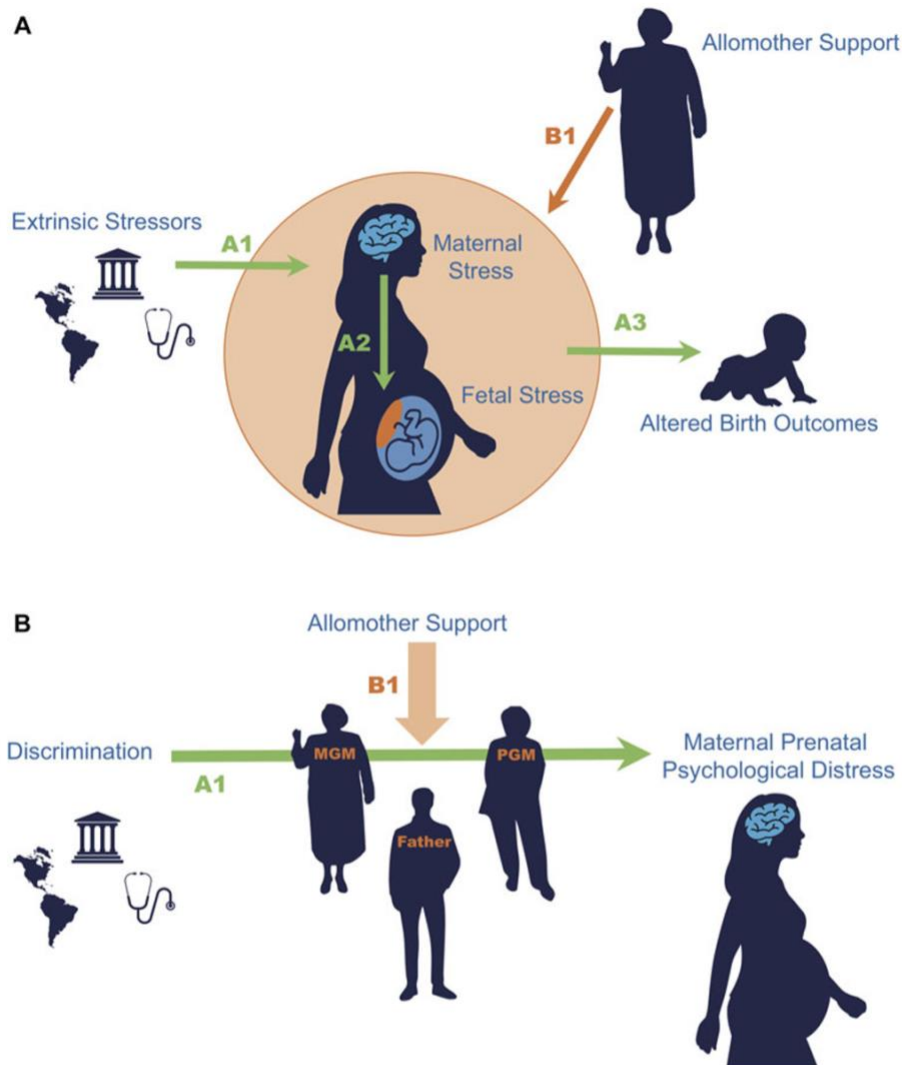
Figure 1. Panel A depicts a broader conceptual model connected to the overall state of the literature. There is an epidemiological trend of extrinsic stressors relating to altered birth outcomes (path A). This trend likely stems from stressors negatively influencing maternal psychological and physiological stress systems (path A1), which are biologically signaled through the placenta in a way that impacts fetal growth and development trajectories (path A2) that ultimately lead to altered birth outcomes like low birth weight (path A3). Overall, we suggest that allomothers may be motivated to buffer this cascade (path B1) for the benefit of the developing infant. Panel B depicts the conceptual model of this study. In this paper, we focus on how allomaternal relationship characteristics (particularly between grandmothers and mothers) buffers (B1) the relationship of extrinsic stressors and maternal distress (A1). This particular paper focuses on how the relationship of discrimination and psychological distress is moderated by allomother relationship characteristics. The abbreviations MGM and PGM stand for maternal and paternal grandmother, respectively.

We have argued elsewhere that allomothers may be adaptively motivated to offset prenatal risks to the offspring for inclusive fitness benefits, extending allomaternal care to the prenatal period (Figure 1A; Knorr & Fox, 2023). Thus, allomothers may buffer maternal prenatal psychosocial stressors because such stressors relate to offspring fitness. Our previous work found that greater levels of

emotional social support from and communication with maternal grandmothers, over and above father involvement, was related to lower prenatal psychological distress for mothers. Here, we extend this argument beyond assessing if mothers' allomother relationships correlate with reduced psychological distress to investigate if these relationships directly buffer maternal stressors (Figure 1B).

A psychosocial stressor often studied in this pathway is racial/ethnic discrimination (henceforth 'discrimination'), or how people are unjustly grouped and differentially treated by society. While race/ethnicity is not biological, issues related to discrimination have long been recognised for their association with increased psychological distress and physical health (Pascoe & Richman, 2009; Williams et al., 2003). Depression was found to mediate the effect of discrimination on physical health among Latino immigrants (Cariello et al., 2022). Recent work further suggests a causal link; for example, increases in discrimination over time are linked to higher rates of psychological distress and depression, but not the other way around (Williams et al., 2018).

Here, we analyse data from a cohort of pregnant Latina women in Southern California to ask if allomothers buffer the prenatal psychological distress associated with discrimination. Latinos are the largest demographic group in California (Public Policy Institute of California, 2020), and often experience unique institutional barriers and psychosocial stressors. Institutional barriers (such as limited access to economic and social resources like higher education and equitable healthcare) and psychosocial stressors (such as discrimination and mistreatment in healthcare) are often due to institutional racism and cultural incompetency of people in power (American Psychiatric Association, 2017; Santos et al., 2021). For foreign-born Latinos, language barriers and concerns about deportation are also common psychosocial stressors (American Psychiatric Association, 2017).

Unfortunately, a salient experience for many Latinos living in the US is ethnic discrimination. Hence, we chose to focus on discrimination because of its strong implication in the DOHaD literature and the Latino-American experience. In a PEW research study conducted in 2021, 54% of Latinos reported experiencing some discrimination event in the last 12 months, with the number higher for certain sub-groups (PEW Research Center, 2021). Frequent perceptions of discrimination, including everyday discrimination, has been shown to be a significant source of stress (Williams & Mohammed, 2009). Recent events in US politics have also led to increased discrimination and negative sentiment against Latinos as well as increased psychological distress among Latinos living in the US (Fox, 2022; PEW Research Center, 2018). Examples of recent political events and circumstances that could detrimentally influence Latino mental health include negative statements against Mexican Americans and other Latino groups by US President Donald Trump during his 2016 campaign and term as president, the growth of White-nationalist terrorist groups, as well as increasingly aggressive rhetoric regarding immigration at the border leading to the inhumane treatment of Latino migrants at the US–Mexico border. Our research question is particularly meaningful for our cohort of Latina women owing to (1) the unique forms of discrimination in the US and (2) the high rates of perinatal mood disorders and adverse birth outcomes among Latinas.

Latina women experience rates of psychological distress 20% higher than non-Latina White women (CDC, 2019) and a disproportionate burden of depression during and after pregnancy. Latina women living in the US report elevated rates of postpartum depression compared with non-Latina White women (46.8% compared with 31.3%; Howell et al., 2005). These disparities are similarly pronounced for depression during pregnancy (Gavin et al., 2011), although prenatal depression is studied less often than postnatal. Rates of maternal depression are also impacted by generational status; second-generation (US-born) Latina women experience substantially higher depression (44%) compared with first-generation (foreign-born) Latina women (34%; Huang et al., 2007). More exposure to ethnic discrimination during pregnancy is associated with more depressive symptoms longitudinally across pregnancy among an ethnically diverse cohort (Noroña-Zhou et al., 2022), suggesting that pregnancy is a vulnerable period throughout gestation and that discrimination effects are cumulative.

Psychological distress can become embodied or 'get under the skin', which contributes to health disparities between minority and majority ethnic groups (Gravlee, 2009). For pregnant women, embodiment of adverse experiences can influence stress physiology and, in turn, fetal development,

birth timing and infant outcomes (Path A in our conceptual model, Figure 1A). Indeed, connections between discrimination and greater cortisol during pregnancy, lower offspring birth weight, shorter gestation length and greater stress reactivity in infants have been repeatedly observed (Carty et al., 2011; Collins et al., 2004; Thayer et al., 2019) (Path A2). Previous studies cast discrimination as a robust predictor of Latina perinatal psychological health and the trajectories of health for the next generation (Paths A1 and A3). Specifically for Latinas, greater levels of discrimination were associated with elevated rates of depression and anxiety among 150 pregnant Latinas, at 24–32 weeks' gestation and 4–6 weeks postpartum, while controlling for acculturation, acculturative stress and economic hardship (Santos et al., 2021). In a multisite cohort study of approximately 2000 Latina and Black women, those who experienced higher levels of discrimination were more likely to give birth prematurely compared with those who experienced discrimination less than once per year (Fryer et al., 2020). Discrimination during pregnancy has been associated with increased odds of low birth weight, mediated by depression among a two-thirds Latina cohort (Earnshaw et al., 2013). Analysis of multi-generational birth records reveals that any advantages of foreign-born birth weight, compared with the non-Latino White majority, disappear in subsequent generations and disappear more rapidly among Black Americans than Latino Americans (Andrasfay & Goldman, 2020; Collins et al., 2002), further suggesting that it is the exposure to socio-economic disadvantage and discrimination that creates a birthweight disparity between ethnic groups. Thus, this particular cohort (Latina pregnant women) and psychosocial stressor (ethnic discrimination) are a well-documented backdrop against which to ask our allomothering research question.

Humans have a flexible roster of kin and non-kin who help the mother–child dyad (Kramer, 2010). Grandmothers are often critical allomothers perinatally because of their experience, knowledge and availability owing to their own non-reproductive phase of life. Most studies on grandmother inclusive fitness suggest that the benefits to grandchild survivorship are mostly apparent at weaning age (Hawkes et al., 1998; Meehan et al., 2013). Other scholars have extended the window of critical grand-maternal care to the perinatal period including during breastfeeding, at birth and during pregnancy (Knorr & Fox, 2023; Myers et al., 2021; Rosenberg & Trevathan, 2002; Scelza & Hinde, 2019). While variation exists and is ecologically dependent (Hill & Hurtado, 2009; Strassmann & Kurapati, 2010), maternal grandmothers (MGMs) are associated with grandchild health benefits more consistently than paternal grandmothers (PGMs) (Chapman et al., 2021; Coall & Hertwig, 2010; Nenko et al., 2021; Sear & Mace, 2008; Strassmann & Garrard, 2011). While the maternal grandfather may also play a support role during pregnancy, we chose to focus on the grandmothers owing to the shared reproductive experiences of women.

Motivated by the lack of research on allocare during pregnancy, we previously found that maternal, but not paternal, grandmother social support (specifically, emotional support) and communication in the same cohort had a direct and positive effect on pregnant women's mental health (Knorr and Fox, 2023). That was the first paper, to our knowledge, that took an overtly evolutionary lens on social support during pregnancy. This paper, in contrast, considers the stress-buffering potential of different allomothers during pregnancy.

Our research question is salient to our cohort of Latina women living in the US as many cultures within the 'Latino' ethnic category share a prioritisation to family in decision-making and deference domains – a concept known as *familismo* (Sabogal et al., 1987). A longitudinal study among Mexican-American women living in Arizona found that values of *familismo* appeared to buffer the harmful effects of discrimination on depression, while neighbourhood cohesion did not (Curci et al., 2022). We therefore can focus on the role of family specifically over other social units (like neighbourhood). Emotional support from family has been shown to buffer psychological distress associated with high levels of everyday discrimination experienced by Asian Americans (Mossakowski & Zhang, 2014). Among Mexican-American adults living in California, the negative physical health effects of discrimination were only seen among the group where instrumental social support was low; additionally, the number of family members in the US was also protective against the ill-effects of discrimination (Finch & Vega, 2003). Based upon previous postnatal allomaternal research and our previous

findings of a prenatal allomaternal effect, we predict that MGMs will exert a positive effect on maternal mental health, and the relationship of maternal discrimination with negative mental health will be attenuated for those mothers who have higher levels of MGM emotional support, communication, and geographic proximity (Pathway B1 in Figure 1). Similarly based on previous findings, we predict weaker effects for PGMs' influence buffering maternal prenatal psychological distress.

We analyse the grandmother relationship characteristics of emotional support, communication and geographic proximity, respective to the pregnant mother, because they capture unique parts of the grandmother–mother relationship. Emotional support is a critical component of psychological stress-buffering (Turner & Marino, 1994). Generally, the construct of social support measures the care provided by or potentially available from a known individual, which can come in many forms including emotional, informational and instrumental (Dunkel Schetter & Brooks, 2009). We chose an emotional support metric for several reasons. Firstly, previous studies have shown that instrumental and emotional support have different effects on perinatal outcomes (Bedaso et al., 2021; Emmott & Mace, 2015). Secondly, emotional support has been extensively tied to stress-buffering in pregnant cohorts (Bedaso et al., 2021; Seguin et al., 1995), while instrumental support has been shown to buffer stress and improve emotional well-being during pregnancy only when emotional support was also present (Morelli et al., 2015). Additionally, our measure of social support is a subjective measure that asks how satisfied the pregnant mother is with the emotional support she receives. A subjective measure of support allows us to describe how much help a woman receives above or below expected amounts of emotional support. Therefore, the difference in how much maternal and paternal grandmothers may be expected to help is already included in the models as it is measured by the participant's own assessment.

During pregnancy, women exhibit unique psychological responses and sensitivities to stressors, justifying the need to examine this effect in the context of pregnancy (Slade et al., 2009). Additionally, the relationships between discrimination, emotional support and mental health during pregnancy must be examined carefully because of the complex interactions between these constructs. For example, African-American pregnant women who reported greater experiences of discrimination (owing to race, gender, age and education) also reported lower levels of social support (Dailey, 2009; specifically, Dailey uses the 'Interpersonal Relationship Inventory' which assesses emotional support). In contrast, Giurgescu et al. (2017) find that while social support and discrimination were independently associated with psychological well-being in a cohort of 107 African-American pregnant women, there was no significant interaction of these two variables on psychological well-being. Social support in Giurgescu et al. is assessed by the Medical Outcomes Study Social Support Survey, which is built to be a general metric of many domains of social support but includes many emotional support items. Thus, more research is needed for understanding the influence of discrimination and various domains of social support on psychology in pregnancy among different groups of people.

Geographic proximity is a variable used in much of the classic grandmother literature to proxy grandmother involvement (Callaghan et al., 2006; Chapman et al., 2018; Engelhardt et al., 2019; Eshete et al., 2019; Kemkes-Grottenthaler, 2005; Madrigal & Meléndez-Obando, 2008; Voland & Beise, 2002). Greater geographic proximity between grandmother–mother–offspring is usually associated with better mother–offspring outcomes (Chapman et al., 2018; Engelhardt et al., 2019; Sear & Mace, 2008; Strassmann & Garrard, 2011). In historical and non-market integrated societies (i.e. societies that practice foraging, pastoralism, or other forms of subsistence living), greater proximity is often a strong predictor of social support generally. However, in market-integrated societies, many types of social support do not depend on geographic location; for example, emotional, informational and financial support can be exchanged at great distances through phone or internet connections. Therefore, our study implementing a comparison of geographic proximity and communication allows us to see a clearer picture of grandmother–mother relationships since geographic proximity reflects physical availability and instrumental support and communication reflects emotional and informational support.

Greater levels of family communication among adult, immigrant Mexican women were associated with greater levels of perceived emotional support (Vega et al., 1991). However, communication itself is not inherently positive and can reflect and exacerbate negative relationships. Verbal conflict among grandmother–mother relationships has been associated with negative parenting and child behaviour outcomes (Barnett et al., 2012). We measure communication levels broadly, so both positive and negative allomother interactions are possible. We capture how communication may influence maternal psychology in either direction.

Latinos share high rates of both multigenerational residence (grandmothers and grandchildren living in the same home) (PEW Research Center, 2010) as well as, conversely, high rates of geographic separation owing to their being the largest immigrant group in the US (PEW Research Center, 2020). This built-in contrast of close and far proximity is a further boon to our study. Overall, our research question integrates DOHaD frameworks and evolutionary theory. At the same time, our question addresses how and through what means family networks support pregnant women during vulnerable periods and in vulnerable situations.

2. Methods

2.1. Cohort

This study emerges from Wave 1 of Mothers' Cultural Experiences (MCE) study, a multi-site cohort among whom data were collected in 2016–2018 to answer research questions surrounding culture, stress and mental health. This project used an observational study design with self-report survey data from 361 pregnant and postpartum women. Women were approached in clinic waiting rooms across four sites in Southern California and asked if they met the following eligibility criteria: (1) self-identified as Latina, Chicana, Hispanic, or Mexican; (2) spoke English or Spanish; (3) were pregnant or recently postpartum; and (4) 18 years of age or older. Participants answered a 30–45-minute questionnaire independently and were compensated $10. Data is not publicly available because participants did not consent to sharing individual-level data publicly.

For this study, women who did not meet the eligibility criteria ($N = 13$) did not receive social support scales in their survey versions ($N = 87$), and those who were postnatal ($N = 104$) were removed before analysis leaving a final analytic cohort of $N = 216$ (some overlap of disqualifications). The 87 women who did not receive social support scales were the first women recruited in the MCE study, receiving Version 1.0 of the survey. Several measures were added with the implementation of Version 2.0 in order to maximise the number of constructs assessed. We dropped these earliest participants from analyses here in order to avoid non-random missingness. Since our research question involves expanding allocare research into the realm of pregnancy, we did not analyse data of postnatal participants.

2.2. Variable operationalisation

Predictor variable: discrimination

We used the validated Everyday Discrimination Scale as the primary predictor in both models, with instructions to consider each question in relation to their ethnicity/race (Williams et al., 1997). This scale has been cross-analysed in different ethnic groups and genders (Lewis et al., 2012) finding overall similarities except differential item functioning for one to two items depending on ethnic group. Since all participants self-identified as part of the same ethnic group, differential item functioning is unlikely to be an issue here. Indeed, we find overall high reliability of the discrimination measure with an overall Cronbach alpha (α) of 0.90. This Cronbach α is 0.91 for English-speaking participants (αE) and 0.86 for Spanish-speaking participants (αS). For a break-down of the items and values in all validated scales used in this study, see the Supplementary Material.

Outcome variables: maternal prenatal mental health

The maternal mental health outcome variables are operationalised with the following validated questionnaire-based instruments: Edinburgh Perinatal Depression Scale (Cox et al., 1987), Spielberger

State-Trait Anxiety Inventory – Short Form (Marteau & Bekker, 1992) and the Shortened Perceived Stress Scale (Cohen et al., 1983). We find the following reliabilities for depression $\alpha= 0.85$ ($\alpha E = 0.86$, $\alpha S = 0.84$); state-anxiety $\alpha = 0.81$ ($\alpha E = 0.84$, $\alpha S = 0.77$); and perceived stress $\alpha = 0.52$ ($\alpha E = 0.86$, $\alpha S = 0.33$). Owing to the low PSS Cronbach's α in the Spanish version, post-hoc, we repeated the PSS models separately for the cohort subsets who took the survey in English and Spanish and did not find evidence of differential effects by language (see the Supplementary Material).

Predictor variables: allomother relationships characteristics
We define family roles based on each individual's relationship to the fetus. Although the relationships are not typically titled this way until after the offspring is born, for clarity we will describe relationships from the perspective of the fetus: MGM, father and PGM. Maternal grandmother in this study is the mother who raised the pregnant participant. While a biological relationship was not required for our analysis, only 3.3% of MGMs were reported as not the biological mother to our participants (Table 1). Similarly, we define the fetus's father as who the participant felt would be the main father figure; in all cases, this was either her current relationship partner or the biological father. In our cohort, 87% of participants were in a relationship, 95% of which were with the baby's father (Table 1). The PGM is who participants identified as their baby's father figure's mother. Instructions to the participants clarified that this might be the participant's mother-in-law, boyfriend's mother or someone else.

To measure each allomother's emotional support, we used the validated Multidimensional Scale of Perceived Social Support (Zimet et al., 1988), which measures an individuals' general perception of acceptable levels of social support from different sources. For this study, we adapted the four-item family sub-scale of Multidimensional Scale of Perceived Social Support to refer specifically to the baby's grandmothers and father. Therefore, participants were asked to rate social support from specific individuals on a three-point Likert rating on four statements (e.g. 'I get the emotional help and support I need from my mother'), which was then averaged (Zimet et al., 1988). Since half of the items directly reflect emotional support and the more general items did not change the mean scores when removed, we conclude that the scale is primarily a reflection of emotional support (see Supplementary Material in this paper and in (Knorr & Fox, 2023). Our data showed a high internal reliability for the emotional support scale adapted for the MGM $\alpha = 0.94$ ($\alpha E = 0.94$, $\alpha S = 0.93$), PGM $\alpha = 0.94$ ($\alpha E = 0.95$, $\alpha S = 0.93$) and father $\alpha = 0.97$ ($\alpha E = 0.97$, $\alpha S = 0.97$).

Communication and geographic proximity were each operationalised based on one question: 'How nearby does your [mother/baby's father/baby's father's mother] live?/¿Qué tan cerca vive su [madre/ padre de su bebe/madre del padre de su bebé]?' and 'How often do you communicate with your [mother/baby's father/baby's father's mother]?/¿Qué tan seguido se comunica con su [madre/padre de su bebe/madre del padre de su bebé]?' For each question, participants were offered a list of options. For communication, options were 1 = every day, 2 = more than once a week, 3 = more than once a month, 4 = once a month or less and 5 = never. We reverse-coded so that greater numbers indicated greater levels of communication. For geographic proximity, options were 1 = in my home, 2 = in my neighbourhood, 3 = outside my neighbourhood but close enough to visit during the day and 4 = too far to visit during the day. We reverse-coded this variable so greater numerical values were associated with greater levels of geographic proximity.

Control variables
We included six covariates in each model: father relationship characteristics (i.e. father emotional support, communication and geographic proximity), maternal age, trimester, parity, foreign-born status and a composite measure of socio-economic status (SES). We take into account father relationship characteristics in order to ensure that any significant PGM association was not just a proxy for father involvement. We do not use relationship status because of high collinearity with father relationship characteristics, which was a higher priority control variable. For SES, we made a composite variable, used elsewhere (Fox, 2022; Knorr & Fox, 2023), that unitises and sums the MacArthur Subjective

Table 1. Demographics of the study cohort and descriptive statistics of the measures used in this study. SD: standard deviation. See SM for explanation of clinically significant cut-off scores for depression.

	Total (N=216)
Age	
Mean (SD)	29.8 (6.12)
Median [Min, Max]	29.4 [18.1, 45.3]
Missing	13 (6.0%)
In A Relationship?	
Yes	188 (87.0%)
No	23 (10.6%)
Missing	5 (2.3%)
Parity	
Nulliparous	71 (32.9%)
Parous	138 (63.9%)
Missing	7 (3.2%)
Trimester	
First	17 (7.9%)
Second	47 (21.8%)
Third	131 (60.6%)
Missing	21 (9.7%)
Education	
Less than High School	30 (13.9%)
High School or Equivalent	142 (65.7%)
More than High School	36 (16.7%)
Missing	8 (3.7%)
Food Insecure	
Food secure	110 (50.9%)
Food insecure	82 (38.0%)
Missing	24 (11.1%)
Everyday Ethnic Discrimination	
Mean (SD)	0.771 (0.647)
Missing	14 (6.5%)
Depression (EPDS) (full scale range)	
Mean (SD)	5.71 (4.71)
Missing	8 (3.7%)
State Anxiety (full scale range)	
Mean (SD)	1.68 (0.585)
Missing	11 (5.1%)
Perceived Stress (full scale range)	

(Continued)

Table 1. (*Continued.*)

	Total (N=216)
Mean (SD)	5.16 (2.57)
Missing	9 (4.2%)
Social Support from baby's Maternal Grandmother	
Mean (SD)	2.65 (0.579)
Missing	15 (6.9%)
Social Support from baby's Paternal Grandmother	
Mean (SD)	2.10 (0.778)
Missing	29 (13.4%)
Social Support from baby's father	
Mean (SD)	2.71 (0.590)
Missing	9 (4.2%)
Do you know who your baby's biological father is (or probably is)?	
Yes	199 (92.1%)
No	9 (4.2%)
Missing	8 (3.7%)
Is your baby's biological father your current relationship partner?	
Yes	178 (82.4%)
No	5 (2.3%)
Does not apply, not in a romantic relationship	24 (11.1%)
Missing	9 (4.2%)

Socioeconomic Status Scale (Adler et al., 2000), maternal education (operationalised as 'less than high school', 'high school or equivalent' (examples of high school equivalency include receiving a General Education Diploma, which the US and Canada uses to certify attainment of knowledge equivalent to high school education) or 'more than high school' (including bachelor degrees or higher, some college, or a vocational degree)) and food security (2-Item Screen to Identify Families at Risk for Food Insecurity by Hager et al. (2010)). All other covariates used a single question (e.g. foreign-born status = 'What country were you born in?/¿En que país nació?'). We control for SES, foreign-born status, maternal age, trimester and parity because these were suspected as possible confounders owing to previous studies demonstrating associations with mental health (Bottino et al., 2012; Campos et al., 2008; Freeman et al., 2016). These covariates may all theoretically influence the relationship and availability of different alloparents as well (Supplemental Figure S2). Despite the high comorbidity of depression and anxiety (Hirschfeld, 2001), we did not control for other mental health variables in our particular model because this could open backdoor paths and create confounding owing to collider variables (Supplemental Figure S1).

2.3. Statistical models

The overarching research question is: do allomothers buffer the association of stressors, such as discrimination, with maternal prenatal psychological distress? We answer this question with two sets of multiple linear regression models: (1) testing the association of discrimination and maternal prenatal psychological distress; and (2) testing how allomother relationship characteristics moderate

the relationship between discrimination and maternal prenatal psychological distress. We expect the first set of models (henceforth, Set 1) to be significant as this is a well-established relationship in the literature. After replicating this finding in our dataset, we explore the second set of models (henceforth, Set 2) by adding an interaction term. This interaction term serves as a stress-buffering measure with three characteristics of the allomother–mother relationship: (a) emotional support, (b) communication and (c) geographic proximity. Each model in Set 2 assesses stress-buffering on three separate measures of psychological distress: depression, state-anxiety and perceived stress. All models control for the same list of covariates described above. All statistical models were conducted using RStudio and R version 4.0.3 and packages including tidyverse, ggplot2, mice, lmtest and car (Fox & Weisberg, 2019; van Buuren & Groothuis-Oudshoorn, 2011; Wickham, 2016; Wickham et al., 2019; Zeileis & Hothorn, 2002). For a complete list of packages used, see the code provided.

This study was pre-registered at https://osf.io/sn7e4.

Model Set 1: is discrimination is associated with psychological distress?

$$Y_{Psychological\ Distress} = \beta_0 + \beta_{1\ Discrimination} + \beta_{i\ Covariates}$$

Model Set 2: do allomother relationship characteristics moderate the association of discrimination and mental health?

$$Y_{Psychological\ Distress} = \beta_0 + \beta_{1\ Discrimination} \times (\beta_{2-4\ Relationship\ characteristics\ with\ each\ allomother}) + \beta_{i\ Covariates}$$

2.4. Missingness, imputation, power analysis and regression diagnostics

The analytic dataset had 7% overall missingness. In order to preserve sample size, we used multiple chain imputation with the MICE package in R, which uses group-level relationships between variables to impute five complete datasets (Section 2 in the Supplementary Material and Figure S3). The data are probably missing at random because the analytic cohort does not include any individuals who have systemic missingness (for post-hoc analysis surrounding our missing at random assumption, see Section 2.1 of the Supplementary Material).

We conducted regression analysis on each of the five imputed datasets and then pooled the output. Our models have 12 predictors (four variables of interest, five control variables and three interaction variables). With a sensitivity analysis for F-tests in G*Power (v3.1) and our parameters set to an α-error of 0.05 and a sample size of 216, our models can detect effect sizes down to 0.084 with 80% power (a medium effect size). Regression diagnostics, including Breusch–Pagan tests and variation inflation factor calculations, were run iteratively on all the models. These diagnostics are included in the Supplementary Material (Supplementary Tables S7–9). From these tests, we decided to use robust standard errors in all models to account for heteroscedasticity and remain conservative in our estimates.

3. Results

The women in our cohort were, on average, 29 years old (18–45 years old, standard deviation 6.12), in a relationship (87%), parous (63.9%), in their third trimester (60.6%) and educated with high school equivalency (66%) or less (14%) (Table 1). There was variation in the perceived levels of discrimination and psychological distress reported in this cohort, with high rates of self-reported depression (16.7%) and anxiety (22.7%) similar to what has been reported for Latina pregnant and postpartum women in other studies (Ponting et al., 2020). Additionally, Latinos disproportionately experience food insecurity in the US (16–22% compared with the national average of 11–14%; Rodriguez et al., 2021), although we find even higher levels of reported food insecurity among our cohort (38%).

3.1. Discrimination

In the first set of models, discrimination was a significant predictor of all three psychological distress measures. As predicted, higher self-reported levels of ethnic discrimination were associated with higher maternal depression (pooled β, 2.58; robust SE, 0.49; p-value < 0.001), state-anxiety (pooled β, 0.22; robust SE, 0.06; p-value < 0.001) and perceived stress (pooled β, 1.30; robust SE, 0.27; p-value < 0.001) (Table 2; Figure 2). Since these measures are all on unique scales the betas cannot be compared across models.

3.2. Grandmother stress-buffering

In the second set of models, we evaluate how allomother relationship characteristics moderate the association between discrimination and psychological distress. As predicted, the interaction of MGM emotional support with discrimination moderated the relationship of discrimination and depression (pooled β, −1.61; robust SE, 0.73; p-value, 0.03) and of discrimination and anxiety (pooled β, −0.28; robust SE, 0.10; p-value, 0.005) (Table 3; Figure 3). Additionally, the interaction of MGM communication with discrimination was a significant moderator of discrimination and depression (pooled β, −0.78; robust SE, 0.39; p-value, 0.045), anxiety (pooled β, −0.14; SE, 0.05; p-value, 0.006), and stress (pooled β, −0.47; SE, 0.22; p-value, 0.035) (Table 4 and Figure 3). The PGM was not a significant moderator of any discrimination–psychological distress relationship. Geographic proximity of allomothers was not a significant buffer for any discrimination–psychological distress relationship (Table 5; Figure 3).

Table 2. Regression Results of Model Set 1 - The Relationship of Ethnic Discrimination and Prenatal Psychological Distress

	Depression	State Anxiety	Perceived Stress
Intercept	4.28	1.68***	3.77***
	(2.20)	(0.26)	(1.13)
Ethnic Discrimination	2.58***	0.22***	1.30***
	(0.49)	(0.06)	(0.27)
Socio-Economic Status	−0.97*	−0.09	−0.48*
	(0.43)	(0.05)	(0.23)
Age	0.01	0.00	0.01
	(0.06)	(0.01)	(0.03)
Trimester	0.26	−0.03	0.39
	(0.58)	(0.07)	(0.31)
Parity	−0.26	−0.02	−0.22
	(0.26)	(0.03)	(0.14)
Foreign Born	0.41	−0.12	0.26
	(0.63)	(0.08)	(0.37)
R-squared	0.17	0.10	0.15

The relationship of reported levels of everyday ethnic discrimination (row 2) on maternal depression, state-anxiety, and perceived stress (columns 1-3, respectively), holding certain covariates constant (row 3-7). Each cell contains the pooled beta, with stars indicating significance level (***p < 0.001; **p < 0.01; *p < 0.05) and pooled robust standard errors in the parentheses. Each model was run on a sample of N = 216. R^2, the pooled coefficient of determination indicating how much variation in mental health is explained by the predictor and control variables, is also presented. Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (F-statistics; p-values): depression (5.959; <0.0001), state anxiety (3.704; 0.001), perceived stress (5.314; <0.0001).

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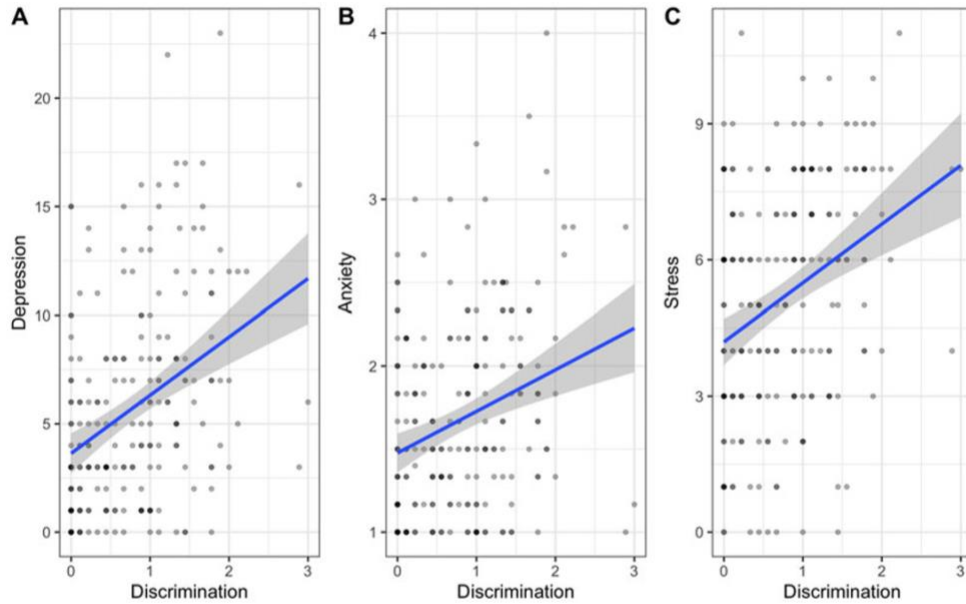
Figure 2. This figure shows the relationship between ethnic discrimination and depression (panel A), state anxiety (panel B), and perceived stress (panel C). The blue line represents the calculated beta slope from the regression model, while the gray shaded region represents the 95% confidence intervals of the estimates. These plots show non-pooled beta slopes from regressions using imputed dataset 2. We chose one dataset randomly, for clarity. The dots show up darker if there are multiple participants occupying that space.

4. Discussion

Motivated by the epidemiological trends tying stressors to low-birth weight and preterm birth, we evaluate whether grandmothers buffer the psychological distress pregnant mothers experience from the stressor of racial/ethnic discrimination (henceforth discrimination) (Figure 1). In previous studies of postnatal allomothers, MGMs are shown to have a particular importance in offsetting the energetic expence of motherhood by providing childcare and direct provisioning of grandchildren during weaning (Hawkes et al., 1998; Meehan et al., 2013). Grandmaternal allocare also occurs during the prenatal period (Knorr & Fox, 2023). Here, we show that MGM can directly buffer the negative psychological response to stress during pregnancy. For Model Set 1, we replicate previous findings that discrimination is a significant stressor implicated in self-reported levels of depression, anxiety and perceived stress among pregnant women (Giurgescu et al., 2017; Mukherjee et al., 2016; Santos et al., 2021). For Model Set 2, we find that the relationship between maternal prenatal psychological distress and discrimination was moderated by greater levels of emotional support and communication with MGMs over and above any buffering effects of fathers. These results are consistent with the plausibility of the theoretical model presented in Figure 1, where MGMs are engaging in stress-buffering activities for pregnant mothers, potentially to improve the birth outcomes and later-in-life fitness outcomes of grandoffspring.

Research on grandmothers as critical allomothers often operationalises MGM and PGM help through proxies like grandmaternal survival, co-residence or geographic proximity, as these studies are most often conducted with historical records (e.g. Kemkes-Grottenthaler, 2005; Madrigal & Meléndez-Obando, 2008; Voland & Beise, 2002). Our work improves upon these studies by measuring a particular aspect of grandmother support more explicitly *in addition to* proxy variables like geographic proximity. This is

Table 3. Regression Results of Model Set 2 - How the interaction between emotional support and ethnic discrimination relates to prenatal psychological distress

	Depression	State Anxiety	Perceived Stress
Intercept	9.70*	1.65***	4.76*
	(3.73)	(0.45)	(2.01)
Ethnic Discrimination	7.02*	1.22***	3.56*
	(2.84)	(0.35)	(1.64)
Baby's Maternal Grandmother (MGM) - Emotional Support	0.30	0.20	0.47
	(0.91)	(0.11)	(0.52)
Baby's Paternal Grandmother (PGM) - Emotional Support	−0.79	−0.05	−0.42
	(0.69)	(0.09)	(0.41)
Baby's Father (F) - Emotional Support	−1.14	−0.08	−0.33
	(0.95)	(0.12)	(0.58)
Socio-Economic Status	−0.87*	−0.08	−0.44*
	(0.42)	(0.05)	(0.22)
Age	−0.02	0.00	−0.00
	(0.06)	(0.01)	(0.03)
Trimester	0.15	−0.05	0.34
	(0.53)	(0.06)	(0.30)
Parity	−0.30	−0.02	−0.23
	(0.25)	(0.03)	(0.13)
Foreign Born	0.26	−0.14	0.23
	(0.60)	(0.08)	(0.37)
Ethnic Discrimination × MGM Emotional Support	−1.61*	−0.28**	−0.69
	(0.73)	(0.10)	(0.43)
Ethnic Discrimination × PGM EmotionalSupport	0.60	0.00	0.57
	(0.64)	(0.09)	(0.36)
Ethnic Discrimination × F Emotional Support	−0.73	−0.12	−0.67
	(0.87)	(0.12)	(0.52)
R-squared	0.29	0.21	0.22

The moderation of emotional support from allomothers on ethnic discrimination (row 11-13) on depression, state-anxiety, and perceived stress (column 1-3, respectively), holding certain main effects (rows 2-5) and covariates (rows 6-10) constant. Each cell contains a pooled beta, with stars indicating the significance level (*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$) and robust standard errors in the parentheses. Each model was run on a sample of N = 216. R^2 is also presented. Model comparisons calculated from 5 imputed data sets against their respective null models produced the following pooled F-statistics and p-values (respectively) for depression (5.760; <0.0001), state-anxiety (4.503; <0.0001), and perceived stress (3.563; <0.0001).

similar to other postnatal studies that have also explored multiple domains of grandmothering (Emmott & Mace, 2015; Myers et al., 2021; Scelza & Hinde, 2019; Sheppard & Sear, 2016).

We predicted weaker effects for PGMs based on previous research. Consistent with this prediction, we find no evidence of PGM stress-buffering. This may be due to the absence of an effect or simply our analyses being underpowered to detect a smaller effect size compared with that of MGMs. The magnitude of each effect might be different for MGMs vs. PGMs given differences in expectations of help. Our emotional support measure is a subjective measure that asks women if they are satisfied
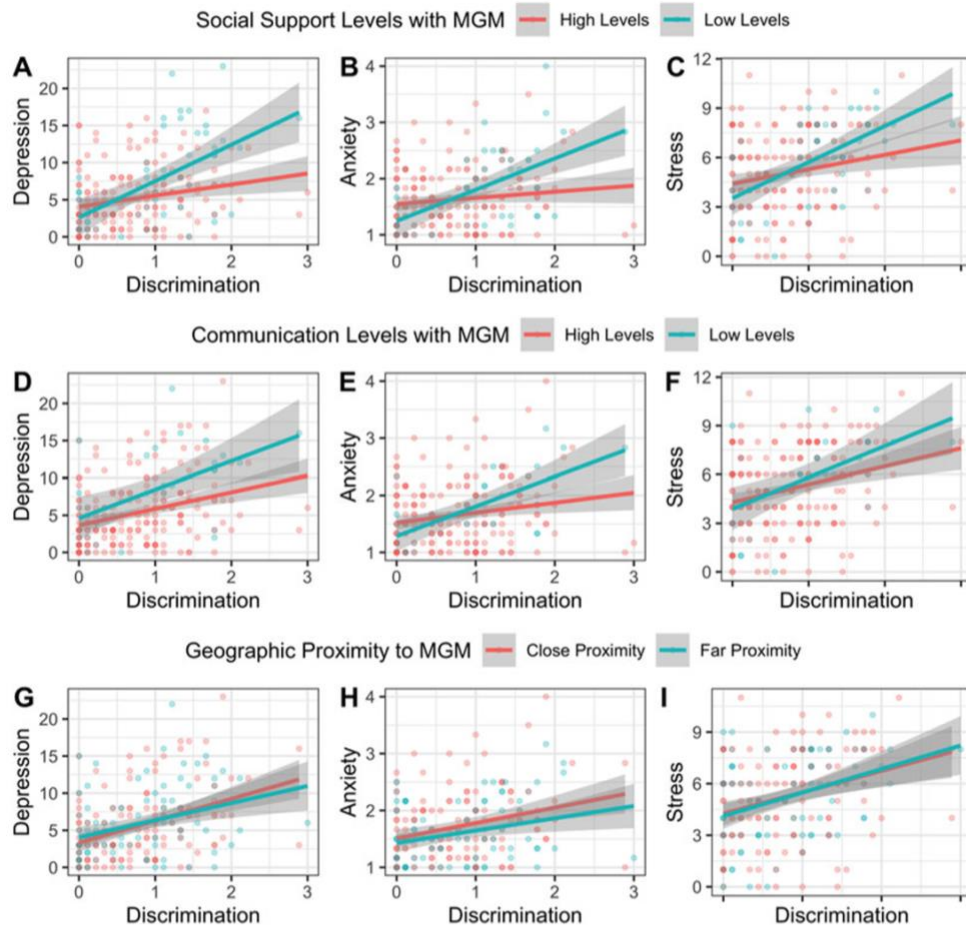
Figure 3. The How the interaction between allomother relationship characteristics and ethnic discrimination relates to prenatal psychological distress

with the level of support they are receiving from this person, so these differences in expectations of help are already included in the participant's assessment of social support. In contrast, geographic proximity and communication are objective measures, allowing us to harness both perspectives to compare different allomothers. Maternal grandmothers may be more consistent buffers of stress because mother–daughter relationships reflect a lifelong intimacy that is not comparable with mother-in-law relationships or even romantic relationships. Other cultural reasons may also account for this difference.

Since ethnic discrimination is such a rampant and distinct problem in large-scale, diverse societies like the US, these results may also be relevant to the minority health research discourse. Family relationships, specifically MGM–mother relationships, may play a particular role among Latina mothers, contributing to resilience against the ill effects of discrimination. This is an especially important public health application given that discrimination has been associated with adverse birth outcomes (Earnshaw et al., 2013; Fryer et al., 2020). Adverse birth outcomes, like low birthweight and preterm birth, are frequent causes of infant morbidity and mortality (Callaghan et al., 2006; Eshete et al., 2019). The developmental origins of health and disease framework explains how maternal psychological

Table 4. Regression Results of Model Set 2 - How the interaction between communication and ethnic discrimination relates to prenatal psychological distress

	Depression	State Anxiety	Perceived Stress
Intercept	7.75*	1.28**	3.01
	(3.81)	(0.46)	(2.06)
Ethnic Discrimination	6.61*	1.01**	4.03*
	(2.75)	(0.35)	(1.60)
Baby's Maternal Grandmother (MGM) - Communication	0.01	0.12*	0.43
	(0.46)	(0.06)	(0.27)
Baby's Paternal Grandmother (PGM) - Communication	−0.38	−0.09	−0.29
	(0.45)	(0.05)	(0.25)
Baby's Father (F) - Communication	−0.28	0.05	0.01
	(0.51)	(0.07)	(0.30)
Socio-Economic Status	−1.02*	−0.10	−0.48*
	(0.42)	(0.05)	(0.23)
Age	−0.02	0.00	0.00
	(0.06)	(0.01)	(0.03)
Trimester	0.30	−0.03	0.37
	(0.55)	(0.07)	(0.30)
Parity	−0.32	−0.03	−0.23
	(0.26)	(0.03)	(0.14)
Foreign Born	0.29	−0.12	0.31
	(0.63)	(0.08)	(0.37)
Ethnic Discrimination × MGM Communication	−0.78*	−0.14**	−0.47*
	(0.39)	(0.05)	(0.22)
Ethnic Discrimination × PGM Communication	0.20	0.03	0.24
	(0.49)	(0.05)	(0.26)
Ethnic Discrimination × F Communication	−0.32	−0.07	−0.32
	(0.49)	(0.06)	(0.29)
R-squared	0.24	0.16	0.19

The moderation of communication from allomothers on ethnic discrimination (row 11-13) on depression, state-anxiety, and perceived stress (column 1-3, respectively), holding certain main effects (rows 2-5) and covariates (rows 6-10) constant. Each cell contains a pooled beta, with stars indicating the significance level (*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$) and robust standard errors in the parentheses. Each model was run on a sample of N = 216. R^2 is presented. Model comparisons calculated from 5 imputed data sets against their respective null models produced the following pooled F-statistics and p-values (respectively) for depression (3.669; <0.0001), state-anxiety (2.655; 0.005), and perceived stress (2.788; 0.003).

distress may modulate stress-related biochemical processes *in utero*, leading to adverse birth outcomes and affecting the offspring's lifespan disease-risk (including cardiovascular disease, obesity, diabetes, and psychopathology) (Thornburg & Marshall, 2015).

Family is a critical aspect to resilience. Individuals who report higher levels of *familismo* values tend to have greater levels of social support (as measured by the Medical Outcomes Study, a validated social support scale which reflects emotional support) as well as reduced risk of affective disorders (Campos et al., 2008). Our findings suggest that communication and emotional support are more critical buffers

Table 5. Regression Results of Model Set 2 - How the interaction between geographic proximity and discrimination relates to prenatal psychological distress

	Depression	State Anxiety	Perceived Stress
Intercept	3.35	1.43***	2.61
	(3.12)	(0.38)	(1.69)
Ethnic Discrimination	3.55	0.28	2.20
	(2.14)	(0.30)	(1.28)
Baby's Maternal Grandmother (MGM) - Geographic Proximity	0.12	0.07	0.19
	(0.40)	(0.05)	(0.22)
Baby's Paternal Grandmother (PGM) - Geographic Proximity	0.06	−0.08	0.14
	(0.54)	(0.07)	(0.28)
Baby's Father (F) - Geographic Proximity	0.08	0.03	0.01
	(0.51)	(0.07)	(0.28)
Socio-Economic Status	−0.95*	−0.10	−0.48*
	(0.43)	(0.05)	(0.23)
Age	0.02	0.01	0.02
	(0.07)	(0.01)	(0.03)
Trimester	0.20	−0.03	0.36
	(0.60)	(0.07)	(0.32)
Parity	−0.29	−0.03	−0.23
	(0.27)	(0.03)	(0.14)
Foreign Born	0.52	−0.08	0.44
	(0.68)	(0.09)	(0.39)
Ethnic Discrimination × MGM Geographic Proximity	−0.14	−0.03	−0.12
	(0.39)	(0.05)	(0.22)
Ethnic Discrimination × PGM Geographic Proximity	0.27	0.12	0.13
	(0.59)	(0.08)	(0.32)
Ethnic Discrimination × F Geographic Proximity	−0.32	−0.06	−0.25
	(0.48)	(0.06)	(0.25)
R-squared	0.18	0.14	0.17

The relationship of discrimination (row 2) on depression, state-anxiety, and perceived stress (columns 1-3, respectively), holding certain covariates constant (row 3-7). Each cell contains the pooled beta, with stars indicating significance level (*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$) and pooled robust standard errors in the parentheses. R^2, the pooled coefficient of determination indicating how much variation in mental health is explained by the predictor and control variables, is also presented. Each model is run on a sample size of 216. Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (F-statistics; p-values): depression (1.302, 0.230), state anxiety 1.039; 0.406, perceived stress (1.528; 0.133).

of discrimination than geographic proximity. This work suggests that encouraging strong social ties to community and extended family is important, supporting a broader anthropological discussion that an exclusively mother–father family unit is not better or even best (Sear, 2016). While in-person MGM care may be critical for instrumental support, these results show that maintaining positive relationships over the phone or internet could also have real and meaningful benefits.

5. Limitations

Our data does not include measures of fitness, such as number of children, grandchildren or offspring survivorship, so we make no claim of testing fitness. Additionally, our cross-sectional and observational design does not allow us to draw causal inferences. We also are limited by the scales used; for example, the discrimination scale does not ask about cumulative exposure to ethnic discrimination. Nor do we ask about intersectional experiences of discrimination, such as discrimination owing to gender or weight. Both cumulative exposures and the intersectional nature of identity can alter the experience of discrimination. We use the term 'Latina' to describe people who have been grouped together by wider socio-political power structures in addition to a specific set of cultural identities and experiences. Within this term, there exist many cultures and lifestyles, which we do not claim to fully capture.

While we suggest that emotional support is decoupled from geographic proximity and can act independently, we did not test whether certain types of remote communication were more effective for transmitting emotional support compared to others.

6. Conclusions

This study finds that discrimination is a significant stressor implicated in self-reported levels of depression, anxiety and perceived stress among pregnant Latina women. Additionally, we observe that MGMs buffer mothers' psychological response to stress during pregnancy. This suggests that MGMs are likely participating in prenatal stress-buffering activities for mothers. Future work may connect these prenatal activities to improved birth outcomes and later-in-life fitness outcomes of grand-offspring through longitudinal study designs and the inclusion of infant outcome measures.

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Appendix C: Supplementary Materials for Chapter 4

C.1 Operationalization of variables

C.1.1 Discrimination

Discrimination was operationalized with the Everyday Discrimination Scale (EDS), which quantifies multiple aspects of ethnic/racial discrimination and the frequency of their occurrence with 9 items on a 4-point Likert scale (Krieger et al., 2005; Shariff-Marco et al., 2011; Williams et al., 2008). For the specific items and values of the scale, see Table S1.

Supplemental Table S1: Everyday Discrimination Scale Item Break-Down

EDS Item Text	
English	**Spanish**
Have you been treated with less respect than other people?	¿Ha sido tratada con menos respeto que otras personas?
Have you been treated unfairly at restaurants or stores?	¿Ha sido tratada injustamente en restaurantes o tiendas?
Have people criticized your accent or the way you speak?	¿Ha sido criticada por su acento o la forma en la que habla?
Have people acted as if they think you are not smart?	¿Han habido personas que han actuado como si pensaran que usted no es inteligente?
Have people acted as if they are afraid of you?	¿Han habido personas que han actuado como si le tuvieran miedo?
Have people acted as if they think you are dishonest?	¿Han habido personas que han actuado como si pensaran que usted no es honesta?
Have people acted as if they're better than you are?	¿Han habido personas que han actuado como si ellos fueran mejor que usted?
Have you been threatened or harassed?	¿Han habido personas que la han amenazado o acosado?
Have you been followed around in stores?	¿Ha sido monitoreada o seguida en tiendas departamentales?

EDS Item Values		
Text of answer choice		**Numeric value**
English	**Spanish**	
Never	Nunca	1

Rarely	Casi nunca	2
Sometimes	Algunas veces	3
Often	Con frecuencia	4

C.1.2 Social Support

Social support was measured with the Multidimensional Scale of Perceived Social Support (MPSS) - Family Subscale (Zimet et al., 1988). From this validated scale, each item answer ("*Not true*", "*Somewhat true*", "*Very true*") is scored 1-3, respectively, and an average score is taken. We modified this scale to measure social support from a particular individual, rather than family generally. We repeated this scale three times in the survey for baby's father, maternal grandmother, and paternal grandmother. For the baby's maternal grandmother, we used the term "my mother" (to denote the relationship to the participant) and for paternal grandmother we used "my baby's father's mother."

For visualizations, we dichotomized the variable based on the combined median score of MGM and PGM social support levels. This was operationalized as "High" social support (greater than or equal to the median score >= 2.36) or "Low" social support (less than the median score of 2.36).

Supplemental Table S2: Item Breakdown of Multidimensional Scale of Perceived Social Support Scale

MPSS Scale Item Text	
English	**Spanish**
My mother really tries to help me.	Mi madre realmente me trata de ayudar.
I get the emotional help and support I need from my mother.	Yo recibo el apoyo y ayuda emocional que necesito de mi madre.
I can talk about my problems with my mother.	Puedo hablar de mis problemas con mi madre.
My mother is willing to help me make decisions.	Mi madre dispuesta a ayudarme a tomar decisiones.

MPSS Scale Item Values		
English	**Spanish**	**Numeric Values**
Not true	Nada cierto	1
Somewhat true	Algo cierto	2
Very true	Muy cierto	3

Since emotional and instrumental social support have been shown to exert impact on perinatal outcomes differently (Bedaso et al., 2021; Emmott & Mace, 2015), we ask if this validated, but generically named scale, reflects emotional or instrumental support. Item 2 and 3 of the MPSS clearly reflect emotional support, as they describe emotions and interpersonal interactions. Items 1 and 4 are less clear as they describe the assessment of willingness and intent. We explored if the items 1 and 4 act differently than items 2 and 3. With only the emotional support items (2 and 3), we found that the mean score only changed for 6 of the 216 women for the MGM score and 5 women for the PGM score compared to the original calculations for the overall MPSS scale. This along with the strong reliability of the scale (determined through high Cronbach alphas) suggests that items 1 and 4 are not adding noise to the emotional support questions. Therefore, we state that the MPSS scale overall reflects emotional support most strongly of the different forms of social support that can influence perinatal outcomes.

MCE Wave 1 was conducted with multiple versions of the survey in order to maximize the number of constructs assessed. Recruitment began April 15, 2016. We launched a new version (2.0) of the survey on June 20, 2016, which added some survey scales not previously included. Out of the 310 women who completed surveys, 87 women received an early version without social support scales. We opted to drop these women to avoid non-random missingness (for more on this decision, see Section C.2.1).

C.1.3 Communication

Communication was assessed by a single question: "*How often do you communicate with [this person]*?", with response options 1 = *Every day*, 2 = *More than once a week*, 3 = *More than once a month*, 4 = *Once a month or less*, 5 = *Never*. We reverse-coded to ensure that greater numbers indicated greater levels of communication. For visualizations, communication was then operationalized as "High levels of communication" (once a week or more) or "Low levels of communication" (less than once a week).

C.1.4 Geographic Proximity

Geographic proximity was also assessed by one question: "*How nearby does [this person] live*?", with response options 1 = *In my home*, 2 = *In my neighborhood*, 3 = *Outside my neighborhood but close enough to visit during the day*, 4 = *Too far to visit during the day*. We reverse-coded this variable so greater numerical values were associated with greater levels of geographic proximity. For visualizations, we created a binary variable operationalized as 'Close' (in the same home or neighborhood) or 'Far' (outside or further than the same neighborhood).

C.1.5 Mental Health - Depression

The Edinburgh Perinatal Depression Scale (EPDS; Cox et al., 1987; Murry & Cox, 1990) consists of 10 items measured on a 4-point scale. Each item was anchored on a 1–4-point scale (1 - "*No, never*" and 4 - "*Yes, most of the time*").

Supplemental Table S3: Item Breakdown of Edinburgh Perinatal Depression Scale

Reverse Coded	EPDS Scale Item Text	
	English	**Spanish**
	I have been able to laugh and see the funny side of things	He podido reír y ver el lado gracioso de las cosas
	I have looked forward with enjoyment to things	He mirado al futuro con placer para hacer cosas

Reverse Coded		
x	I have blamed myself unnecessarily when things went wrong	Me he culpado sin necesidad cuando las cosas marchaban mal
	I have been anxious or worried for no good reason	He estado ansiosa y preocupada sin motivo
x	I have felt scared or panicky for no very good reason	He sentido miedo o pánico sin motivo alguno
x	Things have been getting on top of me	Las cosas me oprimen o agobian
x	I have been so unhappy that I have had difficulty sleeping	Me he sentido tan infeliz, que he tenido dificultad para dormir
x	I have felt sad or miserable	Me he sentido triste y desgraciada
x	I have been so unhappy that I have been crying	Me he sentido tan infeliz que he estado llorando
x	The thought of harming myself has occurred to me	He pensado en hacerme daño

C.1.6 Mental Health - Anxiety

The Spielberger State-Trait Anxiety Inventory short-form scale (STAI-SF; validated among pregnant women by Marteau & Bekker, 1992), consists of six items, three of which are reversed coded, and anchored on a 4-point scale (1 = "*Not at all"* to 4 = "*Very much"*) with items like, "*I am worried.*"

Supplemental Table S4: Item Breakdown of Spielberger State-Trait Anxiety Inventory Scale

Reverse Coded	STAI-SF Item Text	
	English	**Spanish**
x	I feel calm	Me siento calmada
	I feel upset	Me siento disgustada
x	I feel content	Me siento contenta
x	I am relaxed	Estoy relajada
	I am worried	Estoy preocupada
	I am tense	Estoy tensa

C.1.7 Mental Health - Perceived Stress

The 4-item Perceived Stress Scale (PSS-4) is a widely used psychological instrument for measuring the perception of stress (Cohen et al., 1983). It measures the degree to which situations in one's life are appraised as stressful.

Supplemental Table S5: Item Breakdown of PSS-4 Scale

Reverse Coded	Item Text	
	English	**Spanish**
	How often have you felt that you were unable to control the important things in your life?	¿Con qué frecuencia ha sentido que usted no puede controlar las cosas/momentos importantes en su vida?
x	How often have you felt confident about your ability to handle your personal problems?	¿Con qué frecuencia se ha sentido usted segura acerca de su habilidad de manejar sus problemas personales?
x	How often have you felt that things were going your way?	¿Con qué frecuencia ha sentido que las cosas van a su manera?
	How often have you felt difficulties were piling up so high that you could not overcome them?	¿Con qué frecuencia ha sentido que sus dificultades se acumulan tanto que no puede superarlas?

C.1.8 Reliability of Validated Psychometric Scales

As noted in the manuscript (Chapter 4), we calculate Cronbach's alpha (a) and find the following reliabilities for depression $a=0.85$(aE=0.86, aS=0.84); state-anxiety $a=0.81$(aE=0.84, aS=0.77); and perceived stress $a=0.52$(aE=0.86, aS=0.33) Of note is the low cronbach alpha for the perceived stress models. This low reliability seems to be driven by the Spanish survey takers. However, we make use of published translations of the perceived stress scale from Dr. Elysia Davis, as seen in (Davis et al., 2004, 2011).

For the post-hoc re-analysis of Set 1 model (which explores the relationship of discrimination and perceived stress), we stratified the model by survey language using the original unimputed dataset. We found the results to remain the same among English speakers (β: 1.740, SE: 0.430, p-value: <0.001, 32 dropped for missingness, overall model F-statistic: 3.823 and p-

value: 0.002) and rendered insignificant for the Spanish speakers (*ß*: 0.488, SE: 0.645, p-value: 0.453, 35 dropped for missingness, overall model F-statistic: 2.389 and p-value: 0.041). However, for both models the betas remained the same direction.

There are likely issues with the PSS scale, but it is beyond our capabilities to account for what these issues may be. While the low Cronbach alpha perhaps casts the stress results as less convincing, we feel that the high Cronbach alpha and similar patterns of anxiety and depression is evidence that these results are not spurious.

C.1.9 Mental Health Thresholds

The clinically significant cut-off thresholds presented in this chapter were only included in Table 1 to help describe the cohort; these thresholds were calculated based on a summation of individual items for the EDPS scale. These summary scores range from 0-30. Scores greater than 10 were identified as likely for at least minor depression. While there is some debate over the proper cut-off score to use, a validation of the EPDS among Spanish-speaking women suggests a cut-off threshold of 10 or 11 (Garcia-Esteve et al., 2003).

C.1.10 Control Variables

While the methods used in this chapter do not allow for causal analysis, the relationship between discrimination and psychological distress has been previously established as causal (Williams et al., 2018). Therefore, we can make use of directed acyclic graphs to help construct our model (Pearl, 1995). A simplified DAG presented here shows that there are many overlapping factors involved in the high comorbidity of psychological distress measures. Each outcome variable represents a collider variable where there are backdoor paths. A factor of collider variables is that backdoor paths are already blocked, so controlling for these variables would open these paths and create possible confounding. Therefore, we do not control for mental health variables in

the discrimination to psychological distress regression models. We continue the same model

design in Set 2 (where interaction terms are added).

Supplemental Figure S1:
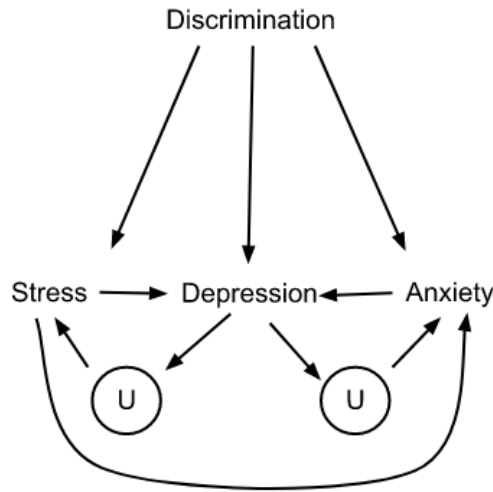
Supplemental Figure S1 Caption: Directed Acyclic Graph (DAG) shows the relationship of variables in our first model (discrimination on mental health). Many arrows are shared between the mental health variables. We do not control for other mental health measures in our models to avoid opening backdoor paths.

Supplemental Figure S2:
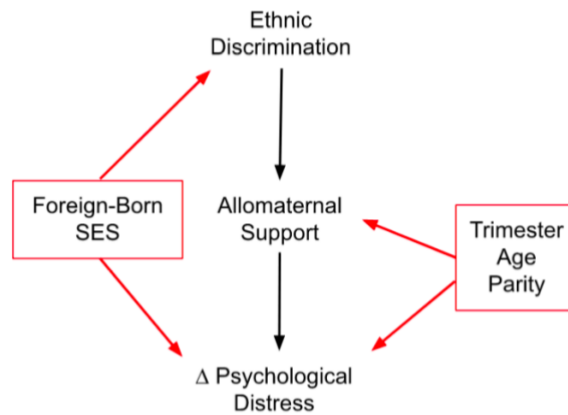
Supplemental Figure S2 Caption: Set 2 measures allomaternal support as a moderator of the relationship of ethnic discrimination and psychological distress, represented in DAG format as change in psychological distress. This graph shows how potential confounders (foreign-born, socioeconomic status, trimester, age, parity) relate to our proposed model. While our model is based on observational data and cannot be interpreted causally, this conceptual modeling offers insights into how we surmise the variables are related.

C.2 Missingness and Imputation

We examined missingness through the Amelia package in R. Overall, 7% of the observations were left blank. Individual variables ranged in missing from 1.4% (foreign-born) to 12.0% (food insecurity). Multiple chain imputation was conducted on the 216 individuals using additional highly correlated variables not in the main analysis to improve accuracy of imputations. Such correlated variables used for imputation analysis included questions on how often you see your baby's grandmother or father in person, general measures of overall family social support, age of immigration, as well as the acculturation level of the pregnant woman, which has been previously shown to be associated with levels of ethnic discrimination (Fox, 2021). Subject ID codes were not included in imputation. We conducted 20 iterations of imputation for each of the five imputed datasets using the MICE package in R.

Density plots were used to determine if imputation was within range for all variables and if the distributions of each variable was maintained across imputed datasets. Red lines indicate the distribution of imputed variables, while blue lines are the distribution of the real data (Figure S3).

Supplemental Figure S3: Density Diagnostic Plot of Imputed Variables
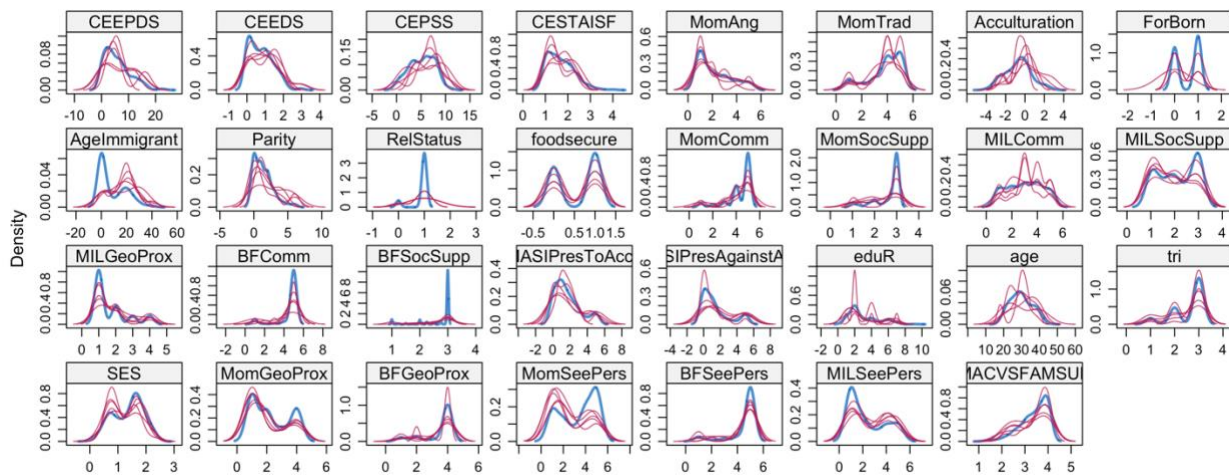
Supplemental Figure S3 Caption: Imputed data was calculated with multiple chain imputation with the MICE package in R. The red lines indicate the distribution of imputed variables, while blue lines are the distribution of the original data.

2.1 Missing at Random Check

The participants who received Version 1.0 of the survey and therefore missing social support scales were not included in the analytic dataset and therefore not relevant for determining missingness at random (for those, it's as if that was an entirely separate study). Since no other systemic missingness is expected, the only other potential cause of nonrandom missingness in the remaining dataset would be participant characteristics. We considered the most likely participant characteristics to cause non-random missingness to be depression status and foreign-born status. We conducted t-tests to explore this question and found that missingness is not statistically different between depressed and non-depressed participants (t-statistic: 1.70, df: 41.35, p-value: 0.10). Missingness was also not statistically different between foreign-born and U.S.-born Latinos (t-statistic: 1.96, df: 209.03, p-value = 0.051); however, it closely approached the commonly used significance threshold of p-value <0.05. To explore this further, we post-hoc stratified the Set 1 models by birthplace. Overall, we find that discrimination remains significant and positively associated with all psychological distress measures for both foreign-born and U.S. born women (see Supplemental Table 6). Thus, we determine that it is likely that our findings are not driven by any asymmetrical missingness.

Supplemental Table S6: Set 1 Models Stratified by Place of Birth

	Depression - FB	Depression - US	State Anxiety - FB	State Anxiety - US	Perceived Stress - FB	Perceived Stress - US
Intercept	4.19	5.48	1.31***	2.04***	2.88	5.44**
	(3.08)	(3.31)	(0.33)	(0.42)	(1.56)	(1.85)
Discrimination	2.45***	2.83***	0.17*	0.26**	1.46***	1.09*
	(0.71)	(0.71)	(0.08)	(0.10)	(0.37)	(0.42)
Socio-Economic Status	-1.07	-0.80	-0.08	-0.10	-0.51	-0.33
	(0.63)	(0.63)	(0.07)	(0.09)	(0.29)	(0.38)
Age	0.07	-0.09	0.01	-0.01	0.04	-0.05
	(0.08)	(0.11)	(0.01)	(0.01)	(0.04)	(0.07)
Trimester	-0.17	0.67	-0.02	-0.03	0.30	0.45
	(0.91)	(0.80)	(0.09)	(0.10)	(0.45)	(0.43)
Parity	-0.29	-0.18	-0.00	-0.03	-0.07	-0.34
	(0.37)	(0.41)	(0.04)	(0.05)	(0.18)	(0.22)

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	Depression - FB	Depression - US	State Anxiety - FB	State Anxiety - US	Perceived Stress - FB	Perceived Stress - US
R-squared	0.18	0.19	0.10	0.12	0.22	0.14
N	120	96	120	96	120	96

Supplemental Table S6 caption: This table parallels Table 2 in the manuscript, and only differs by being stratified on Foreign Born (FB) vs. U.S.-born (US). The new sample size for these models are 120 and 96, respectively. Each cell contains the pooled beta, with stars indicating significance level and pooled robust standard errors in the parentheses. R^2, the pooled coefficient of determination indicating how much variation in mental health is explained by the predictor and control variables and N (or total women in the study) are also presented. Model comparison calculated from 5 imputed data sets against their respective null models produced the following pooled (FB/US: F-statistics; p-values): depression (FB: 3.693; 0.003; US: 3.365; 0.005) state anxiety (FB: 2.185; 0.053; US: 2.153; 0.057), perceived stress (FB: 5.223; <0.001; US: 2.456; 0.032).

3. Regression Diagnostics

For all models, we conducted Breusch-Pagan tests, which tests the null hypothesis of homoskedasticity. We failed to reject the null hypothesis in all state anxiety models and most perceived stress models in both Set 1 and Set 2. Therefore, we used robust standard errors in all models to account for heteroskedasticity and remain conservative in our estimates.

Variance-inflation factors (VIF) were calculated to examine correlations between independent variables to quantify multicollinearity. While some scholars suggest a VIF of 5 or 10 to be problematic (Menard, 2002), others suggest a more conservative 2.5 limit (Johnston et al., 2018). For Set 1, no VIF score was above 2.0. Given the interaction terms added in Set 2, VIF calculations are not appropriate (McClelland et al., 2017). However, given the lack of multicollinearity in Set 1 and the lack of multicollinearity in allomother characteristics with maternal mental health in our previous study (Knorr & Fox, 2023), we do not expect this to be an issue. A breakdown of these calculations can be found in Table S7-S9.

Supplemental Table S7

Regression Diagnostics for Set 1 Models

Model	Maximum VIF	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation #1	1.28	0.012	0.16
Depression Imputation #2	1.26	0.039	0.16
Depression Imputation #3	1.24	0.02	0.14
Depression Imputation #4	1.26	0.073	0.15
Depression Imputation #5	1.26	0.058	0.14
State Anxiety Imputation #1	1.65	0.447	0.43
State Anxiety Imputation #2	1.63	0.591	0.45
State Anxiety Imputation #3	1.61	0.25	0.44
State Anxiety Imputation #4	1.63	0.493	0.44
State Anxiety Imputation #5	1.6	0.561	0.44
Perceived Stress Imputation #1	1.97	0.28	0.36
Perceived Stress Imputation #2	2.04	0.372	0.36
Perceived Stress Imputation #3	1.93	0.096	0.35
Perceived Stress Imputation #4	1.97	0.163	0.35
Perceived Stress Imputation #5	1.92	0.347	0.35

Set 2 includes the addition of interaction terms. Since VIF calculations are not appropriate for interaction models (McClelland et al., 2017), we do not include that column here, but otherwise reproduce the calculations from the previous supplemental table. Similar to Set 1 some tests for heteroskedasticity fail to reject the null, so we use robust standard errors for all models. Column 4 is the adjusted R^2 for each model, which was calculated in order to describe how much variance of the outcome variable is associated with the predictors, including a penalty to account for the number of predictor variables. Residual plots run iteratively on each model for each imputed

dataset did not reveal anything out of the ordinary (e.g., no non-linear relationships or high leverage data points).

Supplemental Table S8

Regression Diagnostics for Set 2 - Social Support

Model	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation #1	0	0.26
Depression Imputation #2	0	0.26
Depression Imputation #3	0	0.24
Depression Imputation #4	0	0.27
Depression Imputation #5	0	0.23
State Anxiety Imputation #1	0.059	0.15
State Anxiety Imputation #2	0.037	0.15
State Anxiety Imputation #3	0.043	0.15
State Anxiety Imputation #4	0.059	0.16
State Anxiety Imputation #5	0.029	0.17
Perceived Stress Imputation #1	0.283	0.19
Perceived Stress Imputation #2	0.535	0.19
Perceived Stress Imputation #3	0.371	0.15
Perceived Stress Imputation #4	0.205	0.16
Perceived Stress Imputation #5	0.442	0.17

Supplemental Table S9

Regression Diagnostics for Set 2 - Communication

Model	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation #1	0.016	0.22
Depression Imputation #2	0.114	0.2

Regression Diagnostics for Set 2 - Communication

Model	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation #3	0.081	0.19
Depression Imputation #4	0.036	0.21
Depression Imputation #5	0.063	0.19
State Anxiety Imputation #1	0.206	0.1
State Anxiety Imputation #2	0.075	0.1
State Anxiety Imputation #3	0.052	0.12
State Anxiety Imputation #4	0.183	0.11
State Anxiety Imputation #5	0.099	0.12
Perceived Stress Imputation #1	0.44	0.17
Perceived Stress Imputation #2	0.436	0.16
Perceived Stress Imputation #3	0.663	0.13
Perceived Stress Imputation #4	0.503	0.14
Perceived Stress Imputation #5	0.357	0.14

Supplemental Table S10

Regression Diagnostics for Set 2 - Geographic Proximity

Model	Breusch Pagan p-value	Adjusted R-squared
Depression Imputation #1	0.074	0.16
Depression Imputation #2	0.049	0.15
Depression Imputation #3	0.11	0.13
Depression Imputation #4	0.183	0.14
Depression Imputation #5	0.112	0.11
State Anxiety Imputation #1	0.141	0.1
State Anxiety Imputation #2	0.001	0.08

Regression Diagnostics for Set 2 - Geographic Proximity

Model	Breusch Pagan p-value	Adjusted R-squared
State Anxiety Imputation #3	0.041	0.1
State Anxiety Imputation #4	0.005	0.09
State Anxiety Imputation #5	0.002	0.08
Perceived Stress Imputation #1	0.148	0.14
Perceived Stress Imputation #2	0.016	0.14
Perceived Stress Imputation #3	0.142	0.11
Perceived Stress Imputation #4	0.025	0.11
Perceived Stress Imputation #5	0.109	0.1

Supplemental Table S11

	Total (N=216)
Where does your mother (baby's maternal grandmother) currently live?	
U.S.	134 (62.0%)
Mexico	48 (22.2%)
Other	15 (6.9%)
Missing	19 (8.8%)
Where does your baby's paternal grandmother currently live?	
U.S.	94 (43.5%)
Mexico	72 (33.3%)
Another country	23 (10.6%)
Missing	27 (12.5%)
Where does your baby's father currently live?	
U.S.	189 (87.5%)
Mexico	12 (5.6%)
Another country	5 (2.3%)
Missing	10 (4.6%)
Communication Levels with baby's MGM	
Talks once a week or more	171 (79.2%)

	Total (N=216)
Talks less than once a week	29 (13.4%)
Missing	16 (7.4%)
Communication Levels with baby's PGM	
Talks once a week or more	76 (35.2%)
Talks less than once a week	113 (52.3%)
Missing	27 (12.5%)
Communication Levels with baby's father	
Talks once a week or more	189 (87.5%)
Talks less than once a week	17 (7.9%)
Missing	10 (4.6%)
Geographic Proximity to baby's MGM	
Lives in the same home or neighborhood	120 (55.6%)
Lives in different neighborhood	74 (34.3%)
Missing	22 (10.2%)
Geographic Proximity to baby's PGM	
Lives in the same home or neighborhood	74 (34.3%)
Lives in different neighborhood	114 (52.8%)
Missing	28 (13.0%)
Geographic Proximity to baby's father	
Lives in the same home or neighborhood	184 (85.2%)
Lives in different neighborhood	17 (7.9%)
Missing	15 (6.9%)
Depression (clinically significant symptoms)	
Depressed (>10)	36 (16.7%)
Not Depressed	172 (79.6%)
Missing	8 (3.7%)
State Anxiety (clinically significant symptoms)	
Anxious (>2)	49 (22.7%)
Not Anxious	156 (72.2%)
Missing	11 (5.1%)

Table S11 Caption: This table presents demographics and characteristics of the study cohort, including both descriptive statistics of the measures in this study and measures relevant to understanding the cohort.

Within each allomothers' relationship with the mother, each relationship characteristic (social support, communication, and geographic proximity) is significantly and positively correlated with the other relationship characteristics. It is important to note that these relationship characteristics are not perfectly correlated with each other, suggesting that these variables overlap in the phenomena they capture but they do not represent a unified factor.

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Chapter 5: *Taking Care*: The Nuances of Family Social Support Among Mexican-American First-Time Mothers

Abstract

Perinatal social support is protective against many stress-related disorders of pregnancy, adverse birth outcomes, and postpartum depression. However, the literature around social support among Latina women is varied, including descriptions of high rates of social support, under-utilization of social support, and stigma against asking for help. In order to understand the trends of worsening health disparities around maternal mental health and birth outcomes for Latina women, this chapter explores intergenerational transmission of stress, reproductive knowledge, and social support. In 2020, I interviewed 14 Latina first-time mothers living in the U.S. about their physical, psychological, and social experiences across the perinatal period. This chapter focuses on 11 Mexican-American mothers living in the Greater Los Angeles Area who gave birth within the last 12 months. All women were children of immigrants and/or immigrated themselves from Mexico to the U.S. before the age of 12, resulting in a shared biculturalism. Using content analysis, I systematically reviewed the semi-structured interviews to identify relevant themes around culture, family, and perinatal social support. In interviews, women shared how their biculturalism was a source of both stress and resilience, how their relationships changed while entering motherhood, and how they feel about asking for help. Existing research suggests that the disconnect between help *received* and help *needed* for Latina mothers comes from not asking for help due to the cross-cultural value of *marianismo* and the guilt surrounding falling short of the 'self-sacrificing' mother ideal. This chapter unpacks how not asking for help can be framed as an act of care for their families, and not something easily targeted by intervention. I suggest that policy should focus on tangible resources rather than individualistic programs. This qualitative

project contributes to perinatal health research by sharing how seeking (and not seeking) perinatal care is embedded in experiences of culture and family.

1. Introduction

The process of becoming a mother involves not only entering a new social role, but also the physical, emotional, and psychological changes that accompany pregnancy, childbirth, and postpartum recovery. Biologically, this transitional period in a person's life requires a social network to help with strains of pregnancy, parturition, and childcare. Humans are often described as cooperative breeders due to our need for perinatal support networks characterized by ample allocare (Kaplan et al., 2000; Kramer, 2010). While all new mothers need help (or 'care'), *who* fills this role is flexible and often culturally dictated (Crittenden & Marlowe, 2008; Kramer, 2005, 2010; Meehan et al., 2014). Culturally, social networks are established and maintained through social institutions (like marriage) and cultural values (like collectivism). Cultural factors also play a significant role in shaping individuals' perceptions and experiences of social support during the perinatal period (Rini et al., 2006). However, there is a gap in understanding *how* cultural beliefs, practices, and norms influence the provision and receipt of social support among diverse populations. Previous studies have proposed that underutilization of social support may be 'culturally normative' in Latino adults (Chang, 2015). This warrants more investigation.

This chapter examines the feelings and experiences of Mexican-American women surrounding their bicultural identities, intergenerational relationships, and receipt of social support (including their own help-seeking behaviors) in the postpartum period following the birth of their first child. Throughout, I show how Mexican-American women see their identity and culture as something they create for themselves. The women whose stories are presented in this chapter all take an agentive and caring role in how they construct their receipt of social support through

strategic use of geographic distance and when/how to ask for help. I explore cultural and evolutionary considerations pertaining to who helps and how, as well as intergenerational knowledge transmissions in the context of their bicultural identities. Overall, this chapter frames the rest of the dissertation by offering a deeper perspective on stressors, mental health, and social support through the stories women tell about themselves.

1.1 On the Use of the Terms 'Mexican-American' and 'Latina'

All interviews I conducted started with a discussion of identity, and all women whose stories are presented in this chapter identified as *Mexican* or *Mexican-American*. Mexican-Americans are the largest segment of the Latino population living in the U.S. (Buriel, 2012). The American Community Survey in 2022 found that most individuals of the approximately 62 million people in the U.S. that identify as Hispanic/Latino identified as Mexican (37 million, compared to 6 million Puerto Rican, 2 million Cuban, and 16 million "other") (U.S. Census Bureau, 2022). The United States Census defines both Hispanic and Latino/a/x/e as "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture…regardless of race" (U.S. Census Bureau, 2021). Utilizing pan-ethnic terms like Latino can obfuscate a lot of internal diversity within the category. In fact, research indicates considerable variation in obstetric outcomes, healthcare utilization patterns, and social determinants of health among Latina subpopulations (Díaz & Díaz, 2022; Mahler, 2018; Weinick et al., 2004). Moreover, the PEW Research Center finds that 48% of surveyed individuals prefer to describe themselves by their country of origin rather than terms like Latino, Latina, Latinx, Latine, or Hispanic (Passel, 2023). Thus, I use 'Mexican-American' to describe the cohort participating in interviews in this chapter, 'Latina' for other cohorts in this dissertation, and Latino/a to describe any finding in the broader literature that uses Hispanic or Latino/a/x/e labels. While this dissertation broadly focuses on

perinatal Latina women because of their shared experiences of marginalization based on societal groupings and treatment (e.g., discrimination), this chapter specifically focuses on the cultural explorations of social support, which requires a more granular understanding of the unique historical, cultural, and social experiences of the women sharing their stories. This specificity allows for a more nuanced understanding of identity formation, community dynamics, and cultural practices.

For many people, national identities (e.g., Mexican, Puerto Rican, Cuban, Salvadorean) represent more than country of origin, but also heritage and cultural belonging (Shenk, 2007). The idea of self-labeling within psychology and sociology suggests that shifts can occur in self-ethnic-labeling over the life course, particularly in and after adolescence, but usually stabilize in adulthood (Syed & Juang, 2014; Tovar & Feliciano, 2009). In sociocultural anthropology, identity can be seen as dynamic and constantly evolving even during ongoing dialogues between individuals and within social movements (i.e., a *dialogic* process) (Holland et al., 2008; O'Connor & Michaels, 2007). For a relevant example of identity being renegotiated in social movements, see de la Torre and Germano's article on the dialogic process of creating the collective and powerful identity of 'DREAMers', individuals who were brought to the U.S. as children without documentation (de la Torre & Germano, 2014). My description of these women as 'Mexican-American' exists somewhere between these two theoretical approaches. I seek to investigate how personal experiences can shape identity. I take a broader life-course perspective (rather than a dialogic one) to suggest that these women, through personal meaning-making processes, form their identities and arrive at a stable view of how they prefer to describe themselves in terms of heritage, ethnicity, and culture.

Disaggregating data by specific identities is essential for understanding the unique health needs and experiences of different subgroups (Gigli, 2021). Of course, even within categories of country-of-origin, there is much cultural and experiential diversity. Failing to recognize these differences and the intersectional identities of the people within each group can lead to a one-size-fits-all approach to healthcare delivery and policy development, which may overlook the specific needs of certain ethnic groups and perpetuate disparities. On the other hand, other scholars have brought up concerns about fragmentation. Within minority populations who already grapple with resource deficiencies, further subdivision into smaller groups may foster competition for attention, resources, and opportunities, potentially exacerbating disenfranchisement (Gigli, 2021). Researchers must balance these two edges of inclusion to make sure specificity and representation are both considered.

In this chapter, I will use an anthropological/feminist lens to unpack the biculturalism of the Mexican-American identity with what women themselves say about it. I will also explore how not mobilizing social support can be an agentive act tied to identity. Additionally, it is important to note that while some women do use the terms Latino/Hispanic in these interviews, not all of them do. For example, one woman with indigenous membership identified as Mexican, but not Latino. This relates to the next section and the historical contexts that shape identity.

1.2 A Brief Account of the History Behind the "Mexican-American" Label

The Mexican-American identity is a product of historical legacies, ongoing social dynamics, and political struggles that continue to shape the lived experiences of individuals and communities across the United States today. Starting in the 16th century, Spanish colonizers began arriving in Mexico, causing significant harm to the indigenous peoples living there through violence, warfare, disease, forced labor, and displacement (Medrano, 2011; Padilla, 1993). Spanish

colonizers imposed their language and writing systems as well as an effective caste system that kept indigenous peoples out of politics (Hidalgo, 1994); thus, creating a new Mexican identity based on hegemonic Spanish practices, education, and institutionalized religious affairs. In 1821, Mexico became independent from Spain. After the Mexican-American War, Mexico ceded half its territory to the U.S. in the 1848 Treaty of Guadalupe Hidalgo, establishing the U.S.-Mexico borderlands in the southwest (Greenberg, 2013).

Throughout the next century, labor migration to the U.S. played a crucial role in shaping Mexican-American identity. Restrictions imposed by U.S. laws in the 20th century created increased surveillance of the borderlands and affected how the country was 'racially and spatially imagined' (Ngai, 2014). Immigration policies, such as the Bracero Program, influenced patterns of migration and settlement among Mexican migrants (Rodriguez, 2022). Increasing anti-Mexican sentiment, from xenophobia and racism, led to disenfranchisement and violence against both Mexican-Americans and Mexican migrants throughout the 20th century. Mexican-Americans have engaged in a strong and long-term collectivist response to these issues by joining labor unions, founding civil rights groups, and organizing their communities (Rodriguez, 2022). One such recent example of this collective activism is seen in the DREAMer identity of undocumented individuals brought to the U.S. (de la Torre & Germano, 2014). Of over 500,000 DREAMers enrolled in the Deferred Action for Childhood Arrivals (DACA) program, 28% live in California and 81% are from Mexico (KFF, 2023; López & Krogstad, 2017).

However, there has been continued negative sentiments toward Mexican immigrants and their children throughout the last 30 years. In 1994, California voters passed Proposition 1874, which restricted the use of public services, like education and healthcare, by undocumented immigrants in addition to directing educators and healthcare professionals to report undocumented

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individuals using these services (Thurber & Partida, 2020). In Los Angeles in 1998, 70,000 to 250,000 protesters marched against the proposition; it was ultimately ruled by a California judge as unconstitutional in 1998 (Thurber & Partida, 2020). Despite support for the Dream Act (to provide a pathway for undocumented immigrants who were brought to the U.S. as children) and the implementation of DACA, the Obama administration deported a record number of undocumented immigrants, including Mexican immigrants, from the U.S. (Krogstad & Gonzalez-Barrera, 2014). More recently, Trump's use of inflammatory language surrounding immigration (including his infamous derogatory statements against Mexican immigrants in his 2015 campaign-announcement speech) has reinvigorated some of the distinct xenophobia and racism against Mexican-American migrants (Dick, 2020).

In response to this history and increasing sociopolitical tensions, the U.S.-Mexico border has become a militarized zone. Significant escalation occurred in the 1990s and early 2000s (e.g., establishment of the Department of Homeland Security) and continues into the present day (e.g., the increasing militarization of law enforcement) (Dunn, 2021). In the past, encounters at the southwestern border primarily involved individuals from Mexico or the Northern Triangle nations of El Salvador, Guatemala, and Honduras. However, in December 2023, 54% of encounters included individuals from countries beyond these four nations (Gramlich, 2024).

1.3 Considerations of Generational Status, Nativity, and Acculturation

1.3.1 Critiquing Acculturation and How to Study Culture

Investigating how individuals navigate the complex process of adapting to new cultural environments is often studied through the construct of acculturation. The academic use of acculturation has shifted from anthropology to psychology to health research (Fox et al., 2017). According to Berry's model in psychological research, acculturation is a process along two

dimensions: the retention or rejection of an individual's native culture and the adoption or rejection of a host culture (Berry, 1992). Acculturation usually measures language use, social customs, religious practices, and lifestyle choices on a spectrum from Host-Culture to Native-Culture, tradition to modernity, and individualism to collectivism (Berry, 2017). Acculturation and the stress associated with this multi-dimensional cultural change has been tied to poorer health in Latino populations generally (Gonzalez-Guarda et al., 2021) and in perinatal outcomes specifically (Lara et al., 2005). In a cohort of Mexican immigrant women, more acculturation was associated with worse health outcomes including higher rates of preterm birth and low birth weight (Callister & Birkhead, 2002). It is important to remember that acculturation is not always voluntary.

There are ample critiques of acculturation as a construct used in psychological and health research, including that it has little predictive power, uses inconsistent research methodologies, conflates culture and national identity, homogenizes culture into a few essentialized traits, and exists in an ahistorical context (Guarnaccia & Hausmann-Stabile, 2016; Kunst & Sam, 2013; Lopez-Class et al., 2011; Tardif-Williams & Fisher, 2009). Many scholars highlight that narrative and qualitative methodologies offer greater potential to understand acculturation experiences (Edwards & Lopez, 2006; Sussner et al., 2008; Tardif-Williams & Fisher, 2009). Additionally, acculturation should be re-conceptualized as a **process** that is continually re-negotiated, not only across the life-course (Fox et al., 2017), but relationally constructed in different contexts (Tardif-Williams & Fisher, 2009).

1.3.2 Anthropological Framing

Health research often focuses on patterns of beliefs that can impact behavior within a population, and bundles these beliefs into constructs and models that can be used in quantitative statistical tests. In contrast, anthropological framings seek out the complexity and variation within

those beliefs and behaviors, usually qualitatively. Additionally, sociocultural anthropologists increasingly question the usefulness of the concept of "culture" as a bounded and easily defined system, arguing that it may be too broad and lead to oversimplifications and generalizations about human behavior (Guarnaccia & Hausmann-Stabile, 2016). Instead, anthropologists promote use of 'thick description' and considerations of culture as a meaning-making system that shapes and constrains human behavior (Geertz, 1973). Moreover, the postmodern turn has brought a broader intellectual shift within social sciences, including anthropology, away from grand theories and universal truths toward more nuanced and contextual understandings of social phenomena. In the context of acculturation scholarship, this postmodern turn has led to a reevaluation of traditional frameworks and theories used to study cultural adaptation. Socio-cultural scholars are now more likely to emphasize the complexities and diversity of individual experiences of acculturation rather than seeking overarching explanations or models. This chapter takes a more postmodern perspective in the use of 'acculturation' as a term to mean negotiating between American-ness and Mexican-ness for these women.

Similarly, language is seen by postmodern scholars as a site of power struggles and contested meanings. So, what do I mean by "*bicultural*" identity, when individuals shape and negotiate their identities every day? From feminist theory, we can take a practical cautionary tale that "in deconstructing categories of meaning, we deconstruct not only patriarchal definitions of 'womanhood' and 'truth' but also the very categories of our own analysis-'women' and 'feminism' and 'oppression'" (Mascia-Lees et al., 1989, p. 27). For practical reasons, I use 'biculturalism' in this chapter to account for the large, and continual, impact of two cultural streams of influence (American values and practices from their peers and wider society in addition to Mexican traditions and values from their families). Though I acknowledge that individuals shape and

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negotiate their identities every day and likely shift along a spectrum of Mexican-ness and American-ness in different contexts, ethnic identity does usually stabilize in adulthood (Syed & Juang, 2014). Additionally, this is the term (Mexican-American) chosen by the women I talked with; in this chapter, I explore why the term has meaning for them in the context of entering motherhood.

1.3.3 Generational Status and Effects of Nativity on Health

In addition to focusing attention on the largest national/cultural sub-group within the Latino category, I limited recruitment by generational status. In this chapter, I focus on women who are children of immigrants or who were brought to the U.S. before the age of 12. While women in the interviews sometimes call themselves first-generation (as they are the first-generation to grow up in the U.S. or go to school in the U.S.), academic literature describes foreign-born individuals as 1st generation and U.S.-born individuals as 2nd generation. The category that includes children who immigrated before the age of 12 has recently been re-defined as the '1.5' generation, which is understudied and often an invisible, but distinct, generation (Holloway-Friesen, 2008). This recruitment choice centered on maximizing the potential cultural difference between the postpartum women and their parents as a backdrop to exploring social support receipt and mobilization.

The construct of nativity (where a person was born) is often used as a critical predictor of disparities in health outcomes; usually dichotomized as native-born versus foreign born. The interviews presented in this chapter will unpack some of what is lost from collapsing categories in this way. Additionally, I will explore the distinct stressors of biculturalism affecting the 1.5/2nd generation women. Many scholars have noted a 'Latino Health Paradox'/'Immigrant Health Paradox'/'Nativity Paradox' where health outcomes are usually worse for U.S.-born compared to

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foreign-born individuals (as shown in systematic reviews by Cunningham et al., 2008; Mogos et al., 2017; Montoya-Williams et al., 2021, 2022; Vang et al., 2017). Indeed, adverse birth outcomes, like preterm birth and low birth weight, are more likely to occur in U.S.-born women (second-generation) than foreign-born (first-generation) women, above and beyond sociodemographic characteristics (Adegoke et al., 2022). Additionally, a review of 50-years of perinatal health research found substantial evidence of nativity predicting risk for adverse birth outcomes, with U.S.-born birthing people having worse outcomes than their foreign-born counterparts (Montoya-Williams et al., 2022). Montoya-Williams et al. suggest that structural drivers of health (e.g., availability, affordability, and quality of healthcare services) may explain the remaining differences (Montoya-Williams et al., 2022). This cross-sectional pattern can also be reconceptualized longitudinally, as U.S.-born individuals are the offspring (or second generation) to foreign-born (first generation) individuals. Thus, an intergenerational transmission of health risk should be explored.

It is important to remember that generational status and acculturation may vary depending on where the individuals live. For example, long-standing Mexican-American communities may increase local pressures to maintain traditional cultural values (Buriel, 2012). The women in this study were all long-time residents of Los Angeles County (a long-standing Mexican-American community), keeping consistency within our sample and allowing us to reach saturation with a small sample size more quickly (Boddy, 2016).

1.4 Strength in Community: Utilizing Social Support

A significant amount of research has shown that perinatal social support is critical to maternal and infant health. Higher reported levels of perceived social support are linked to improve birth outcomes in the U.S. (Collins et al., 1993; Elsenbruch et al., 2007; Feldman et al., 2000) and

reduced infant mortality in Mexico (Kana'Iaupuni et al., 2005). There are also multiple forms of social support, which have been shown to have different impacts on maternal and infant health (Bedaso et al., 2021; Emmott & Mace, 2015). Social support can be emotional, informational, or instrumental (Collins et al., 1993). Emotional support involves empathetic care for another person, including listening, offering encouragement, and providing comfort to alleviate stress and foster emotional well-being. In contrast, informational support involves providing knowledge or resources to help women navigate particular challenges and make informed decisions. Instrumental support refers to any practical help to directly alleviate burdens. This type of support may include tasks such as childcare, transportation, or assistance with household chores. Instrumental support helps individuals meet their daily demands and obligations, enabling them to focus on their well-being and the well-being of others and is incredibly important for postpartum women. Financial assistance is sometimes considered a form of instrumental support, but it was always described and asked about as distinct from instrumental support in this study. To reduce the noise in the literature, many have called for very clear descriptions of which form of social support is being utilized (Myers et al., 2021).

Emotional support has been shown to buffer against psychological distress, thereby improving psychological resilience in both pregnant and non-pregnant populations (Bedaso et al., 2021; Reblin & Uchino, 2008; Seguin et al., 1995; Suls & Wallston, 2003). Instrumental support similarly buffers stress during pregnancy (Collins et al., 1993) and improves well-being, but only if emotional support is also present (Morelli et al., 2015). With qualitative methods, we can explore not only *whether* women receive help, but *how they feel* about the help they are receiving. Open questions persist around the effectiveness of different types of social support for particular communities. Specifically, more research is needed to understand the cultural factors shaping

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individuals' perceptions and experiences of social support, and the barriers to accessing this support. Addressing these gaps in knowledge will be crucial for advancing research in this field and informing the development of effective interventions to support maternal and infant health during the perinatal period.

1.5 Stigma Surrounding Mental Health and Help-Seeking

Stigma is critical to study as it presents significant barriers to accessing appropriate care. Stigma can manifest in various forms upon various targets; for example, self-stigma (or self-stigmatization) refers to the form of stigma that internalizes negative beliefs about one's self (Vogel et al., 2013). This is in contrast to public stigma, which involves general attitudes about certain groups or behaviors (Vogel et al., 2013). In this chapter, I consider public- and self-stigma surrounding mental health as well as self-stigma surrounding help-seeking behaviors.

Psychological struggles remain a pervasive stigma among Latina perinatal women (Eghaneyan & Murphy, 2020; Mendoza et al., 2015; Nadeem et al., 2007; Pérez-Flores & Cabassa, 2021). Consequently, many Latina perinatal women may hesitate to seek support or disclose their struggles with mental health, exacerbating the risk of untreated conditions and adverse perinatal outcomes (Nadeem et al., 2007; Pérez-Flores & Cabassa, 2021). Scholars have called for mental health stigma within these populations to be addressed by culturally sensitive interventions that challenge negative beliefs, promote help-seeking behaviors, and enhance access to culturally competent care (Lara-Cinisomo et al., 2018; Leahy-Warren et al., 2012). Pérez-Flores & Cabassa (2021) conducted the first systematic literature review on mental health stigma interventions of Latino adults in the U.S. and found that most interventions are small pilot studies with short follow-up periods that tend to focus on depression. Their research revealed that employing various strategies such as *fotonovelas* and soap opera narratives, integrating Latino/a music and art, and

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administering these approaches in both English and Spanish at trusted community venues like community centers and schools, led to enhanced mental health literacy. However, these interventions did not diminish stigma (Pérez-Flores & Cabassa, 2021). This chapter explores the reasons behind the potential inadequacy of these interventions in addressing stigma, as they often prioritize individual-level transformations rather than structural reforms.

In response to mental health stigma, help-seeking (usually 'help' in terms of seeking therapy or other mental healthcare) is often delayed or absent (Schnyder et al., 2017). However, there is also a distinctive and less-often-studied 'help-seeking' stigma, where requests for help or social support will be seen as a sign of weakness. Masculinity is often the source of 'help-seeking' stigma, which has been shown to be a robust phenomenon in many cultures (Latalova et al., 2014). In Latino cultures broadly, the cross-cultural value of *machismo* has been shown to inform help-seeking stigma and social support mobilization (Vogel et al., 2011). Lara-Cinisomo et al. (2018) also suggest that issues of stigma may be compounded by the practice of *marianismo*, an oft-cited cultural value that women may seek to fulfill the ideal gender of becoming self-sacrificing mothers, often at the expense of their own needs and autonomy (Morales & Pérez, 2020).

Negron et al. (2013) is the only article, to my knowledge, that directly applies considerations of help-seeking stigma to the question of social support mobilization among minority groups living in the U.S. The authors find that many new mothers feel asking for help may lead to judgment by others that they are not capable of taking care of their children or household duties. When disaggregated by ethnicity and preferred language, Negron et al. (2013) find that English-speaking Latina (N=11) and White mothers (N=10) feared criticisms of parenting skills by asking for help, while Spanish-speaking Latina mothers (N=3) did not want to feel like a burden to their already limited network. Negron et al. do not offer any further exploration of this

difference between English and Spanish-speaking mothers. I seek to explore these differences through person-centered interviewing. The interventions suggested by Negron et al. include bolstering partner/family support and education.

In this dissertation chapter, I will evaluate the claim in the literature that women do not have adequate social support networks (Callister et al., 2011; Hurtado-de-Mendoza et al., 2014). Then I will assess the literature that states that there is a "underutilization of social support" among Latina women (Chang, 2015). Finally, I will assess whether women's reluctance to seek help is due to stigma surrounding maternal competency and explore suggested connections to *marianismo* (Lara-Cinisomo et al., 2019).

2. Methods

I conducted a series of open-ended, semi-structured interviews in English and Spanish with 14 first-time Latina mothers in the summer of 2020 in Los Angeles County. Our conversations focused on relationships, family, social support, cultural identity, and mental health. These interviews were recorded, translated, and transcribed with the help of research assistants. I received ethical approval from UCLA to conduct these interviews (IRB #20-001332).

In this dissertation chapter, I focus on the interviews of the 11 women with Mexican heritage (rather than those with citizenship to or heritage from other countries; i.e., El Salvador, Venezuela, Chile). While all 14 women shared similar sentiments regardless of country of origin, much of the broader literature indicates that there are considerable variations in obstetric outcomes, healthcare utilization patterns, and social determinants of health among Latina subpopulations. Hence the need for qualitative projects that allow women to describe their identities, opinions, and needs *in their own words* and to focus on groups with shared cultural experiences.

Before any interviews were conducted, women were asked to review study information and provide written consent. All consent forms, questionnaires, and other study materials were available in both English and Spanish. Next, women were asked to complete a short questionnaire to gather basic background information (e.g., age) and sensitive information (e.g., number of previous pregnancies/miscarriages). After completing the questionnaire and the first interview, women were compensated with an online gift card, and offered the opportunity to conduct a follow-up interview in the next 3 months. The value of the gift card reflected local hourly wages of middle-class individuals. First interviews often lasted at least 90 minutes. Interviews were conducted over the phone or on Zoom due to the ongoing COVID-19 lockdowns during the summer of 2020 in either English or Spanish. Women were instructed to take the call in places they felt comfortable and were private. I emphasized that women should feel encouraged to take breaks during the interviews as needed, given the fact that they were all caring for young infants.

In the questionnaires, I asked participants to list their social support networks by prompting them to: "*Think of the people who gave you the most support during pregnancy, childbirth, and now with child care.*" I then asked them to list up to five people, instructing them that they did not need to include five people and "*if they didn't feel supported by anyone to skip the section.*" There was no missingness in the survey.

During interviews, I asked questions about what women felt was stressful in their lives, if they felt satisfied with the help they received, and what they would have found most helpful. This last question was important for gathering intervention ideas from the community, mostly intended to create programs or resources as a way of giving back, and do not weigh heavily on the presented research questions. Given the person-centered nature of these interviews, not all questions were asked of all participants, and not in the same order.

I also posed a series of stereotypical findings from the literature to participants to see what women <u>themselves</u> have to say about these findings. I asked women whether they agreed or disagreed with these statements: *1. "Latinos have close knit families", 2. "Latinos are less likely to ask for help from outside their family",* and *3. "Latinas do not want to ask for help from their families because it might make them look like they can't handle motherhood."*

I used the assistance of artificial intelligence (AI) software to create a rough draft of transcribed interviews. I used the service *Otter.ai* for English language interviews and *Sonix.ai* for Spanish language interviews. Once all interviews were roughly automatically transcribed with a semblance of formatting (specifically, AI discriminated between different speakers, labeling them as "Interviewer" and "Participant"), bilingual research assistants then listened to the interviews and edited the transcriptions for accuracy.

To analyze the qualitative interview data, I used content analysis, following the methods laid out in Elo and Kyngäs (2008) and Hsieh and Shannon (2005), to identify patterns and themes. Specifically, these steps include re-familiarization with data (by rereading interviews), generating initial codes, searching for themes, reviewing themes, and defining and naming themes. These steps were done with the assistance of one specifically trained Mexican-heritage bilingual woman research assistant so that the process of making the codes was done with the input of someone with shared cultural knowledge.

Boddy (2016) tackles the problem that there is often no justification given for the sample sizes used in qualitative research. Ultimately, he concludes that samples of size 12 can reach data saturation in relatively homogeneous populations (Boddy, 2016). Given that the 11 analyzed interviews were of women with many overlapping life experiences and with similar family backgrounds justifies this cohort as a relatively homogenous sample that likely reached saturation

point. Many other qualitative studies have similar sample sizes, with much broader inclusion criteria (e.g., Negron et al. (2013) with 14 non-country-specific Latina mothers and Rastogi et al. (2012) with 18 non-country-specific Latino 'community members').

3. Results

The women in this study share the experience of giving birth to and raising their first child within 12 months of the semi-structured qualitative interviews (infant ages ranged 1 month old to 1 year old). Participants were all long-term residents in Los Angeles County and had all finished high school, with some women pursuing higher education (Table 5.1). Women's ages ranged from 19 to 40 years old. All women had parents who were born in Mexico. Three women were born in Mexico and moved before the age of 12, one was born in U.S. but lived in Mexico for 5 years, and 7 women were born in the U.S. and did not live in Mexico for an extended period of time. (Table 5.1).

Table 5.1: Cohort Characteristics

	Overall (N=11)
County of Birth	
Mexico	3 (27.3%)
U.S.	8 (72.7%)
Mother's Age (in years)	
Mean (SD)	29.0 (5.57)
Baby's Age (in months)	
Mean (SD)	6.62 (3.64)
Baby's Assigned Sex at Birth	
Female	5 (45.5%)
Male	6 (54.5%)
Education	

Less than high school or equivalent	0 (0%)
High school, GED, or equivalent	1 (9.1%)
Some college	3 (27.3%)
Certificate, technical or vocational program after completing high school	3 (27.3%)
Bachelor's degree	4 (36.4%)

Relationship Status

Single	2 (18.2%)
In a relationship and living separately	0 (0%)
In a relationship and living together	5 (45.5%)
Married and living together	4 (36.4%)
Legally separated, divorced, or widowed	0 (0%)

9-item EPDS Score (Depression Symptoms)

Mean (SD)	7.00 (7.43)
Median [Min, Max]	3.00 [0, 24.0]

Clinically Depression (9-item EPDS > 10)

Yes	3 (27.3%)
No	8 (72.7%)

Instrumental Support - Do you feel like you are getting the instrumental support (e.g., someone doing chores or helping with the baby) you need right now?

Yes	8 (72.7%)
In some ways, but not in others	3 (27.3%)
No	0 (0%)

Informational Support - Do you feel like you are getting the informational support (e.g., someone showing you how to care for your new baby or help accessing services regarding health, nutrition, or healthcare service) you need right now?

Yes	10 (90.9%)
In some ways, but not in others	1 (9.1%)
No	0 (0%)

Emotional support - Do you feel like you are getting the emotional support (e.g., someone listening to your problems) you need right now?

Yes	8 (72.7%)
In some ways, but not in others	3 (27.3%)
No	0 (0%)

Table 5.1 caption: Demographics and relevant social characteristics of the cohort presented in this chapter. The 9-item EPDS is a validated psychometric scale commonly used to assess perinatal depression; for more on this scale see descriptions in Chapters 2-4 in this dissertation.

While all women were first-time mothers, three women had been pregnant before. Their relationship with pregnancy and preparing for motherhood was thus different. Additionally, the relationships these women had to their baby's fathers and extended family were variable. Most women were in a relationship with the baby's father (4 married and 5 in a relationship and living with the baby's father), and two women were single (Table 5.1). Women felt satisfied with the informational support they were receiving, but had more variable satisfaction with emotional and instrumental support. Specifically, the majority (73%) of women felt satisfied and a significant number (27%) felt satisfied 'in some ways, but not others' for emotional and instrumental support (Table 5.1).

All participants identified as Mexican-American, but not necessarily other labels (e.g., Latino/Hispanic/Chicano). Here are some examples of reasons why certain women did not identify with broader ethnicity labels (note that women were simply asked to share how they identify, and not prompted to comment on ethnicity labels):

> "So, I identify as Mexican-American, I don't consider myself Chicano. I just, I feel like that's a more American version of the culture [than] I identify with. Since my parents are from Mexico, I feel like I have more of their traditions. So, I would describe myself as Mexican-American, that's the culture that I identify with myself." - Adriana

> "I'm Mexican. I'm from indigenous heritage [*Mexica*] and so is my partner and baby…I grew up in the U.S. I was born and raised here." - Marisol (did not identify as Latino on the questionnaire)

The quotes throughout this chapter make use of pseudonyms to humanize and give respect to each participant, while protecting their identities.

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3.1 Response to Stereotypical Research Findings

I asked my interlocutors to reflect on commonly shared stereotypes that are included in health literature to gauge what women themselves think about these comments and to open up a broader conversation on these ideas. Given the open-ended nature of the interviews, and following what women wished to share and talk about, not all women were asked these questions at the same time in the interview.

Table 5.2: Endorsement of Specific Research Findings About Latinos

"Latinos have close knit families"	All women agreed with this statement
"Latinos are less likely to ask for help from outside their family"	9 women agreed with this statement and 2 women disagreed
"Latinas don't want to ask for help from their families, because it might make them look like they can't handle motherhood"	6 agreed, 1 somewhat agreed, and 4 disagreed

Some statements were endorsed by everyone, while other statements were not universally agreed upon. I unpack the nuance this finding suggests in the *Discussion* section.

3.2 Results from Content Analysis

Systematic content analysis resulted in 10 themes under three categories (Figure 5.1). The categories include: (1) mental health, (2) intergenerational relationships, and (3) social support/help. For a detailed list of the finding associated with each theme, with examples, see Table 5.3.

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Figure 5.1: Themes Resulting from Qualitative Data Analysis

Themes

Mental Health	Intergenerational Relationships	Social Support/Help
Stress from Bicultural Identity & Generational Divides	Changing Relationship Dynamics	Willingness of Family to Offer Help
Resilience from Bicultural Identity	Maternal versus Paternal Grandmother	Reluctance to Ask for Help
Mental Health Stigma	Geographic Proximity	Barriers to Asking + Receiving Help
	Conflicting Advice & Culture	

Figure 5.1 Caption: This is a graphical representation of the overall results of the content analysis. In interviews, I focused on women's attitudes and feelings about mental health, intergenerational relationships, and social support (medium blue boxes with white text). In the process of coding the data, I categorized what my interlocutors shared into 10 themes (light blue boxes).

When discussing mental health, women brought up the stigma rampant in their communities that many consider mental health issues as self-imposed, fictional problems (Theme 3 in Table 5.3). This left these new mothers feeling unseen; that their experiences were deemed insignificant and rejected. Similarly, their bicultural Mexican-American identities made them feel misunderstood by and culturally distant from their parents in some ways (Theme 1). However, women also felt that their biculturalism could be a source of resilience to these stressors, as women were prepared to approach problems differently from others, taking only what works for them and leaving the rest behind (Theme 2).

With regard to intergenerational relationships, women shared how relationships changed (Theme 4) and how the help received from maternal versus paternal grandmothers varied (these are the grandmothers to their infants and their own mothers and mothers-in-law) (Theme 5).

Relationships often changed due to an increased intimacy through the perinatal period as well as a greater understanding of what their own mothers went through with motherhood. Women felt that social support from grandmothers was upregulated during pregnancy. Mothers also shared that they innately trusted maternal grandmothers' advice more, even though paternal grandmothers often delivered the advice less harshly. While women spoke of limitations of instrumental support from family due to geographic distance, they described how emotional support could be received regardless of distance (Theme 6). Additionally, geographic distance was sometimes used strategically to avoid childrearing advice they did not want to follow. Conflicting advice, especially from Mexican sources (e.g., family) versus American sources (e.g., their doctors) was described as stressful by women. However, my interlocutors shared that their biculturalism again allowed them to pick the best parts from each side of their cultural identity and leave what did not serve them behind (Theme 7).

When discussing social support, women described a strong community value to always offer help when one can manage (Theme 8). Women also shared that they generally do not like asking for help (Theme 9). Given the cultural value to offer help freely and often, women found it difficult to ask for *more* help on top of what was freely offered, as they did not want to burden their support networks (Theme 10).

Table 5.3: Summary of Findings

Theme	Finding	Examples (*In their own words*)
1. Stress from Bicultural Identity and Generational Divides	Biculturalism can be a distinct stressor, especially in the context of feeling culturally distant from one's parents.	*"Your parents don't understand that you have these two conflicting cultures. You know, like, you want to respect what they saying and you want to do what they say, but you live in a different country now where everybody does things differently… they don't validate a lot of the feelings we have and disregard a lot of our feelings. And I think that's what it goes back to. So, I think it's just that a lot of like, first generation kids have all these unresolved feelings inside them that we [don't] know what to do with."* - Gabriela
2. Resilience from Bicultural Identity	Participants described feeling empowered by the flexibility their biculturalism affords them, particularly when it comes to making health care or parenting decisions.	*"We [children of immigrants] all think the same, but it's not the same as our parents. But it's definitely not American-American…We don't support things that are normally American. We're questioning everything. So it's very unique in that we're not stuck to the ways of America, you know?"* - Paloma *"I know how Mexico is, like, how the country is. I am Hispanic. I [was not] born and raised in Mexico. So I don't have to understand that, like, I understand it, but I don't have to abide by it. I don't have to practice it. I don't have to live by it."* - Carmen
3. Mental Health Stigma	Discussions of mental health often led to descriptions of mental health stigma in their communities as many people in Mexico think mental health problems are "all in the head" or due to some personal shortcoming (e.g., being lazy, spoiled, or weak).	*"I feel like in my culture, you don't really talk about mental health. It's just one of those taboo things that it's like "oh, you'll be fine. You just have to get over it kind of thing."* - Kristina *"Well, I just think cultural-wise, mental health is not something we talk about. It's not even something that like, my culture recognizes as real. And pretty much have you feel anxious or just feeling depressed or anything, it's just like, you're either like spoiled or you're a brat or you're lazy or you know. So it's just like, you don't know how to handle stress. There's always something to disregard whatever it is you're feeling."* - Gabriela

4. Changing Relationship Dynamics	Pregnancy initiated a change in relationships with key family members (focusing on relationships with their own mother and mother-in-law, aka the baby's grandmothers). Often these relationships became more intimate and led to an upregulation of social support during pregnancy.	*"I found out I was pregnant. Um, I think it [our relationship] changed for the better, more communication. I mean, I could relate a lot more with my mom now. After having my own baby and struggles, I sympathize a lot more with my mom, you know, raising four kids. I'm like, 'Oh, my goodness, I just barely raise one'. So, I think she's a big help to me now. So, I think I love her even more now to be honest."* - Elena "*I feel like we communicate more now. And now like, I guess, like me and my mom before we would, like, bump heads a lot. But now that I have my baby, I guess like, I kind of understand, like, where she comes from, and like, you know, like, what she has done to raise us.*" - Jessica
5. Maternal versus Paternal Grandmother	Participants described differences in informational, instrumental, and emotional support between her mother and mother-in-law (baby's grandmothers)	"*Um, I think we [my mother-in-law and me] talk a lot more now. She's just more concerned with me now, she'll ask how I'm doing and how the baby is doing.* [Interviewer: Do you like that new attention?] *Not really, it feels like a loss of privacy."* - Marisol "*I'm just thinking, maybe my mom remembers a lot more things about caring for a baby than my mother-in-law. I felt like, a lot of the times I was kind of- I was the one kind of telling my mother-in-law, you know, like, this is how you do it, you know, like, like, she forgot. I don't know why. I just thought by observing them both you know, I just felt like my mom became more natural, like, caring for a newborn.*" - Elena "*I think the thing about my mother-in-law is just, you know, because she is not my mom, she tends to be kinder sometimes if that I makes sense. I feel like I get kinder advice from her. She just tries to be kinder when she gives me advice, whereas my mom because she is my mom, she has no filter. So, she'll just say things how she thinks.*" -Gabriela

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6. Geographic Proximity	Living at great distances from family is both difficult and strategic for mobilizing social support. Emotional support can still be delivered over great distances, but instrumental support cannot.	*"We have love, they call us so much…we cannot be physically together because we are in different geographical places, but on the phone the love is the same and they are also always looking out for us…I would like them to be closer to us [but] the affection is just as close"* - Lucia [translated from Spanish] *"…because she's [mother-in-law] not here. I don't feel that pressure coming from her that I have to listen to what she says."* - Gabriela
7. Conflicting Advice & Culture	Similar to **Theme 1** (**Stress from Bicultural Identity and Generational Divides**) where participants described feeling culturally distant to family members, many women also described a tension between family members due to differing opinions around health, childcare, and parenting. Participants described grappling with a desire to honor their cultural heritage, while simultaneously seeking to utilize contemporary scientific knowledge.	*"So, the advice I'm receiving from a pediatrician is American, but the advice I received from my parents is Mexican. I mean, it's very different. So it's frustrating sometimes because I understand that what they [my parents] have done has worked for them. But we also -- and I don't want to discard my culture. I love my culture and I believe in a lot of the stuff we do. I also feel like I can't disregard you know, American culture and just the things that they do that do work. Yeah, so I would say sometimes, like when she [my baby] gets sick, and they [my parents] try to help me, it's not welcomed because I feel frustrated. I feel like I can do it on my own, but like, I just kind of feel like they need to mind their business and let me take care of my own house…[But] I just didn't want them to think of it like I don't value their opinion, because I do, no matter like how frustrating it is sometimes. I do always take into consideration what they say and what they do. And most of the time, I end up doing like a variation of what they are telling me, what my baby's pediatrician is telling me, and [whoever] else has an opinion."* - Gabriela *"If I'm telling her [my mom] 'Oh, look at the study', she just won't read it. 'I want you to read the study because after you read the study, you'll realize that you shouldn't do this.' But if I see her continually doing the thing, I'll realize, 'Oh, she didn't even bother reading the study.' So, then I have to explain to her and then she'll think that I'm kind of telling her how to be a mother even though she already did that. I'm like, 'Damn, I don't want to tell my mom how to be a mom' because she's done it already. But at the same time, what I know is different than what she's known. She wasn't educated the way that I'm educated now. She didn't come here to give me a better life so that I could just not know more than she does. I think I do, because that's the kind of life she gave me. I was more educated. So now I can apply those things to my daughter and not do the same as her."* - Paloma

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8. Willingness of Family to Offer Help	Participants described a cultural value that members of their community will always offer help when they can manage it.	*"Traditionally, Mexicans do have that mentality where motherhood should come natural to you due to the notion that this is what women are supposed to do. But I think being Mexican-American, I think that I'm more comfortable reaching out to my mom and asking for help, whereas maybe she [my mother] wouldn't have been as comfortable asking her mom to come help her do this or do that...I would say that for most Mexican families, it's not that you have to ask, they kind of just offer and just come and do it. So, they would just like say, 'Hey, want me to come over today?' And they would come and do it. No questions asked."* – Adriana *"I mean, I feel like just, that's something my mom has shown us, you know, we try to be helpful. So, like I said, we're very family oriented. So, I feel like that has definitely helped, in the sense that we're always trying to help each other and providing like support in any way that we can."* - Jessica
9. Reluctance to Ask for Help	Participants shared a reluctance to ask for help.	*"Definitely me. I don't like asking for help. Since like my family offers, I'm okay with it. I feel kind of bad because of my husband's mom. I feel that she would want to be more involved, but she's not because I don't ask for help. I just don't like asking for help."* - Kristina *"Well yes, one hopes not to have to ask. Like for example now that I've already gone through this [parturition recovery and motherhood]. Now I know how I can help a mother and the things I didn't dare ask for, but if they had told me 'I'll do this', I wouldn't have said no. I would have accepted it if they had offered. But if they are not offered. I didn't feel I could ask"* - Lucia [translated from Spanish]

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10. Barriers to Asking & Receiving Help	Participants shared that their preference to not ask for help was partially motivated by guilt. However, more often this guilt stemmed from knowing that family members are already helping as much as they can, rather than guilt of falling short of the 'self-sacrificing mother' ideal. Women shared that it felt like taking advantage of their support networks to ask for more help.	*"It's already having her [my mom] do a favor for me to even help me watch the baby or clean the house, but having her drive all the way out here, I feel as though maybe I should be paying her. It's just a little embarrassing to have her drive all the way out here to help me do basic things."* – Adriana *"I always feel bad asking my mom for help all the time. I thought, well, not everyone has their mom to help them. So I felt like I shouldn't be having to ask my mom for help all the time"* - Paloma *"It's a little harder for me to ask, like, 'Hey, can you transfer him to this while I go do this?' You know? ... I feel like asking for additional help is like taking advantage, you know, their generosity. So, it is harder for me to ask for help. ... They offer it like when I mentioned 'Oh, yeah, I really need to go to Costco…' But um, but yeah, it's harder for me just because of the fact that they already are taking care of them from Monday to Thursday."* - Elena

4. Discussion

These first-time mothers spoke in interviews about the intensity of the transition into motherhood beyond their expectations, their needs while becoming new mothers, and their feelings about social support mobilization within the context of their bicultural identities as Mexican-American. In order to more deeply explore the intersections of mental health and interpersonal relationships, our conversations focused on how these women *felt* throughout their postpartum experience. First, I will discuss how the bicultural identity of these women frames their experiences. Then, I will discuss how our conversations revealed to me nuances that the broader literature has missed regarding barriers to social support. These findings include evolutionary implications for modern geographic barriers and intergenerational knowledge transmission, as well as the cultural reasons behind not asking for help.

4.1 Mental Health: Unpacking the Stress and Resilience of Bicultural Identity

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I interviewed women who were either children of immigrants from Mexico or who immigrated as children, as this generation is more likely to experience the bicultural tension many Mexican-American women feel. Indeed, several women emphasized this bicultural conflict as a noteworthy source of stress, as evidenced in this quote from Gabriela:

> "So here's the thing. So there is **a lot of tension and there's a lot of frustration** and sometimes it's hard because my partner, he grew up in Mexico, he only came to the United States when he was about 22 years old. So he, like me, I consider myself Mexican. And I consider myself [to have grown] up in Mexico. But I did come to the United States when I was five years old, and I learned the culture and you know, to a certain degree, you assimilate and you learn to understand American culture. But for him, it's different because he was exposed throughout his adulthood to-- to Mexican culture. And so he still holds a lot of like those beliefs and those values, so sometimes **it is hard because it's like, it's him and my parents and his mom against me**...I mean most of the time he tells me that whatever I say goes, but there is a few times where that [tense conflict over parenting decisions] has happened. And it's frustrating because I understand him like why he thinks like that. But sometimes like, **it's hard because I have to not only convince him, but sometimes I feel like I have to convince my parents to see why we do things the way we do them."** - Gabriela

Gabriela highlights the challenges of balancing multiple cultural identities within the context of family dynamics and expectation. She feels frustration around wanting to make different parenting decisions than her parents and partner, and points to growing-up in a different country than them as leading to these conflicts in decision-making. She goes on to discuss the difficulties of expressing her feelings to her parents:

> "**Your parents don't teach you how to handle your emotions. It's just also like– your parents don't understand that you have these two conflicting cultures. You know, like, you want to respect what they saying and you want to do what they say, but you live in a different country now where everybody does things differently. There's a lot of things we don't agree with in American culture, but I feel like there's a lot of things that are good**… There's just a lot of things and I tried to talk to my mom sometimes about how I was feeling. One time I told her, like, I think I'm depressed and she was like, '*Oh, well, you know what the good thing is that now you know, you're depressed so you can just stop.*' Yeah, like, '*Oh, wow, Mom, you just found the cure*'...That like **they don't validate a lot of the feelings we have and disregard a lot of our feelings. And I think that's what it goes back to. So, I think it's just that a lot of like, first generation kids have all these unresolved feelings inside them that we [don't] know what to do with.**" – Gabriela

Disparities in Latina mental health is a motivating issue of this dissertation. As discussed earlier there is a pronounced 'immigrant paradox' trend that shows that many health outcomes, including

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mental health, are worse for the 1.5/2nd generation compared to 1st generation (Cunningham et al., 2008; Mogos et al., 2017). Gabriela describes how mental health stigma and cultural distance from her family exacerbates her experience of stress, anxiety, and depression. This quote from Gabriela sets up an important context for this chapter, as many women in this study endorsed feelings that depression and anxiety are not being recognized by their families, especially their parents:

> "I feel like **in my culture, you don't really talk about mental health. It's just one of those taboo things that it's like '*oh, you'll be fine. You just have to get over it*'** kind of thing." - Kristina

> "My mom has gone through depression, and I think my dad just thinks *'she's just in to her own. She's in her head too much, she can snap out of it*'. Traditionally, that's what our culture thinks of when it comes to depression as well. They just think **it's all in your head** and in [a] sense that **you can just change the way you feel about things and that's the solution**." - Adriana

> "They just kind of don't get that people can be depressed. It's just not an option. They don't understand. *"Why can't she just be normal? Why can't she just get a job? Why can't she just get her license and go to school?"* **They don't see emotion as a factor in people's choices."** - Paloma

Mental health conditions may be stigmatized as a source of shame or embarrassment, leading individuals and families to avoid acknowledging or addressing them. These issues are worsened by other common structural barriers to accessing culturally competent mental health services in the U.S., including a shortage of bilingual and bicultural providers, limited availability of culturally relevant treatment modalities, and financial constraints (Fryer et al., 2021). This lack of access can perpetuate feelings of isolation and reinforce stigma (Rastogi et al., 2012).

While the quotes shared in this chapter so far indicate a lot of tension in bicultural experiences, especially with regard to family relationships and mental health, it is important to note that not everyone in this study framed biculturalism as a stressor. Some women shared that this unique identity affords them flexibility, to be future-oriented and gain the best of both worlds:

> "**We** [children of immigrants] **all think the same, but it's not the same as our parents.** But it's definitely not American-American…We don't support things that are normally

American. **We're questioning everything. So it's very unique in that we're not stuck to the ways of America**, you know?" - Paloma

"I know how Mexico is, like, how the country is. I am Hispanic. I [was not] born and raised in Mexico. So I don't have to understand that, like, **I understand it, but I don't have to abide by it. I don't have to practice it. I don't have to live by it.** Like I could but I don't have to, you know, yeah, that's why sometimes we [me and my parents] clash I believe, because I'm not 101%, like, to their beliefs. … **it just opens up another dimension and I just feel like they don't even understand me.** You know what I'm saying? They don't understand me because I explained to them how my brain works and why my brain reacts the way it does. And then and then they're like, '*Oh*', like they're– **they're still stuck in a little nutshell."** - Carmen

These experiences highlight the complexity around bicultural identities, that women themselves see the advantages and disadvantages it affords them. These mothers inhabit multiple cultural worlds. Additionally, it is crucial to acknowledge throughout this chapter that family relationships can act both as mitigating factors against stress and as independent sources of stress.

From an anthropological perspective, biculturalism is seen as a process rather than a fixed state. This matches what women themselves say: their cultural identity is not the mixture of two fixed and bounded entities, but rather something created from negotiating their individual identity within different contexts into something new. In *Becoming Mexican-American* (1995), Sanchez highlights how discrimination and marginalization based on stereotypes of race, ethnicity, and class was responded to with agency and resistance from Mexican-Americans in shaping their own identities and communities. I will return to this emphasis on agency and re-negotiation in the final section of this chapter.

Moreover, immigration stories within this cohort were not linear and highlight a shortcoming of the large amount of research that pits native-born versus foreign-born against each other when predicting health outcomes (Cunningham et al., 2008; Mogos et al., 2017; Montoya-Williams et al., 2021, 2022; Vang et al., 2017). For example:

"Well, **I identify as Mexican**. My family's from Oaxaca. So, my baby's father is actually from Oaxaca as well. Yeah. So that– that's what I identify as… **I was born in the United States. But when I was about a year old, my mom, she decided she didn't want to live**

in the U.S. anymore. Just because of her experience was just, you know, like, racism and everything. So, she decided to take me back and her problem was that she didn't need to be here and that we could just live in Mexico and you know, just find a way there. Um, however, when we got there, that wasn't the case. So, so she, she got there. And then she found out she was pregnant with my sister. And it was just really hard for her to find the work. **So, I was there for about four or five years. And that's where I grew up. And yeah, so it was just really hard for my mom to, to find work.** You know, there was like no money for food. So, there was days where we wouldn't eat. So, my mom made the decision to come back to the U.S., but because my sister was born here, she couldn't, it wasn't as easy for her to just bring her here. So, we had to wait until my mom could get some money together and find a way to get my sister here. So then about 10 months later she sent for us and then we came back here. And so **when I got here, I didn't speak English. I didn't know about like, American culture like, like, like Mexico was the only place I had been exposed to.**" - Gabriela

Understanding these stress-related immigration stories and how they are moderated by pregnancy and birth experiences is something only possible with qualitative interviewing. Additionally, this quote emphasizes that place of birth as a variable in quantitative social science research can obfuscate a lot of cultural and stress-related experiences, especially for children of immigrants or individuals who immigrated themselves as children.

Issues related to biculturalism in this section were framed primarily around the differences they felt from their parents, and how that informed their mental health and child-rearing decisions. Next, I will focus on how biculturalism may interrupt the flow of intergenerational knowledge transfers, and other nuances surrounding parent-child relationships in adulthood.

4.2 Intergenerational Relationships

4.2.1 Changing Relationship Dynamics

All women rely heavily on community support in the postpartum period. While all new mothers need help, _who_ fills this role is variable (Crittenden & Marlowe, 2008; Kramer, 2005, 2010; Meehan et al., 2014). As described in Chapter 3 and 4, help from grandmothers is particularly high-quality and consistent cross-culturally (Chapman et al., 2018; Emmott & Mace, 2015; Hrdy, 2005; Leonetti et al., 2005; Scelza, 2009; Scelza & Hinde, 2019; Sear, 2018; Sear &

Mace, 2008). In many Latino cultures specifically, there exists a strong tradition of intergenerational caregiving, with extended family members playing a significant role in providing emotional and instrumental support to new mothers (Maldonado, 2017). Grandmothers (*abuelas*), play particularly important roles in Latino families, maintaining family traditions and well-being. The Johns Hopkins Center Health Communication program recommends maternal-infant health communications in Latin America target grandmothers, as they are capable of creating the most significant change within their households and communities (Desmon, 2017).

In interviews, many women pointed to their own mother as a key player for all forms of perinatal social support. Additionally, many women described how relationships intensified during this period, usually for the better. Most women described how they did not truly appreciate what their mothers went through until they had a baby.

> "I found out I was pregnant. Um, I think it [our relationship] changed for the better, more communication. I mean, **I could relate a lot more with my mom now. After having my own baby and struggles, I sympathize a lot more with my mom**, you know, raising four kids. I'm like, '*Oh, my goodness, I just barely raise one*'. So, I think she's a big help to me now. So, **I think I love her even more now to be honest**." - Elena

> "It [my relationship with my mother] changed because **now I look at her in a different light. I feel like I now kind of know what she's gone through with us**. It's not like we're on the same level, but I understand her now and I appreciate her so much more for everything she does for me, did for me before this, and continues to do now that the baby has come." - Adriana

> "I feel like I got closer to my parents just because they were constantly like checking in on me and like, we have more communication. And then after pregnancy, it's the same, like, **I feel like we communicate more now. And now like, I guess, like me and my mom before we would, like, bump heads a lot. But now that I have my baby, I guess like, I kind of understand, like, where she comes from**, and like, you know, like, **what she has done to raise us**." - Jessica

Women described how their mothers started to increase care and affection during their pregnancy, which supports the prenatal allomothering arguments described in Chapter 3 and 4. Specifically, that it may be evolutionarily advantageous for mothers to increase 'allocare' during their daughter's pregnancy. Qualitatively, here are some examples of upregulated care:

"**During pregnancy, my mom spoiled me. She wouldn't have me [do] any type of hard labor.** Even when it came to cleaning, she didn't want me cleaning. I wanted to do it because I was bored. She didn't want me to do any of that. She would massage my legs and feet, because I would swell up a lot. After pregnancy, same thing. Especially right now, since I was doing homework, she would take the baby on. She's been very supportive. I'm very blessed to have my mom." - Carmen

"It was interesting because **I feel like I became her [my mom's] baby again**. **So, she was caring for me as if I was a baby because I had a baby inside of me... She would stroke my hair, which she never did before as an adult**. She would massage my feet and she would talk to me very sweetly. It was really interesting." - Marisol

These quotes offer an intriguing glimpse into the dynamic between pregnant women and their mothers. Both quotes presented here highlight a shift in the maternal relationship during pregnancy, where the daughter becomes the focus of maternal care and treated, in a way, as a child again. This underscores the deep emotional bonds between mother and daughter, as well as the unique emotional experiences of care and increase of support that pregnancy can bring across the family unit.

4.2.2 Maternal versus Paternal Grandmothers

Just as the bond between a mother and daughter changes during pregnancy, so does the relationship between a woman and her mother-in-law, but not always for the better:

"Um, I think we **[my mother-in-law and me] talk a lot more now. She's just more concerned with me now, she'll ask how I'm doing and how the baby is doing.** *[Interviewer: Do you like that new attention?]* Not really, **it feels like a loss of privacy.**" - Marisol

"She [my mother-in-law] is very overprotective of her son. While I was pregnant, she got a little nicer with me. **After giving birth, she wanted to tell me what to do and how to parent. And how to do things which I wasn't agreeing with but I would politely just say '*okay*' or wait. Just thank her.**" - Carmen

In these interviews, I used the term mother-in-law whether or not the participants were married. These women were the paternal grandmothers to the offspring of the interviewees, while participants own mothers are the maternal grandmothers. While many women shared positive experiences of help with paternal grandmother (e.g., '*It's been about the same. We get along pretty*

well.' and other stories highlighting examples of instrumental support), the neutral to negative responses presented here suggest that the mother-to-paternal grandmother relationship has always been more difficult than maternal grandmother-mother relationships. This is supportive of the findings of chapter 3 and 4, where maternal grandmothers significantly buffered the stress experienced by their pregnant daughters, but paternal grandmothers did not.

There is a theme of familiarity and comfort with one's own mother, rooted in years of shared experiences, that the mother-in-law relationship can never catch up to. This is potentially another explanation for the maternal versus paternal grandmother findings presented in chapter 3 and 4. Additionally, women reported that their mothers just seemed more *'natural'* in the role; this perhaps connects to the evolutionary privileging of allocare from maternal grandmothers, despite not being consciously aware of it:

> "I'm just thinking, **maybe my mom remembers a lot more things about caring for a baby than my mother-in-law**. I felt like, a lot of the times I was kind of- I was the one kind of telling my mother-in-law, you know, like, this is how you do it, you know, like, like, she forgot. I don't know why. I just thought by observing them both you know, **I just felt like my mom became more <u>natural</u>, like, caring for a newborn**." - Elena

> "I talked about how I'm very close to my family. **I feel like his [baby's father's] mom gets jealous because she knows that I hang out with them constantly**. And I feel like she kind of wants that too. It boils down to If my mom cooks something and says '*Hey, do you want to come over?*' I go over…**I think the help I get from my mom comes more <u>natural</u>.** Where if she offers to help me, **she kind of knows what to do because she knows the way I am**. **Whereas if I do get help from my mother-in-law, she's too worried about *'Oh my god, am I doing it right?'* It doesn't come off as easier and <u>natural</u> as it would be like my mom**…. **My mom will be more direct and more blunt, whereas when my mother in law does it, it's more of a 'tip'**. She says '*When I had the boys I would do this*' or just very small stuff here and there. Whereas my mom is more direct and a little more blunt. It's easier for me to say '*That won't work for me*' or '*No, mom, this is why I do it.*'" - Kristina

> "I think the thing about my mother-in-law is just, you know, **because she is not my mom, she tends to be kinder** sometimes if that I makes sense. **I feel like I get kinder advice from her. She just tries to be kinder when she gives me advice, whereas my mom because she is my mom, she has no filter. So, she'll just say things how she thinks.**" - Gabriela

> "**My mom is my mom** and she like– **I've known her my whole life** … she'll help me out where she will do stuff with me, and **I'll be like, comfortable asking.** Whereas like **my**

boyfriend's mom, like, I don't know them as long. It took me some time to, like, get comfortable to be able to like ask them for help, or to ask, even ask for a glass of water for me, but now it's like, it's gotten better and like comfortable with her. And so now I have no problem just going up, turn and be like, '*Hey, [can you] take care of the baby and do this for me real quick?*'" - Marta

Some participants perceive their mothers-in-law as offering gentler, kinder advice compared to the directness and bluntness of their own mothers. Despite this, women consistently preferred the help from their own mothers. The directness and honesty of these interactions may proxy the comfort within these adult mother-daughter relationships. This may be the reason maternal grandmother support, especially emotional support, was more impactful in chapters 3 and 4. I did not test informational support in those chapters explicitly, but likely it would have the same maternal-inheritance bias. Overall, the close relationships these women had with their own mothers allowed for allocare and knowledge transfers to be delivered more directly and, seemingly, more easily.

4.2.3 Geographic Proximity

In evolutionary allocare research, geographic proximity is often considered crucial for alloparental support. However, global migration can fracture support systems. While mothers describe postpartum experiences as difficult and endorsed the benefits of having family near-by, they also describe how emotional support can effectively be dispensed across borders:

> *"We have love, they call us so much…we cannot be physically together because we are in different geographical places, **but on the phone the love is the same and they are also always looking out for us**…I would like them to be closer to us [but] the affection is just as close*" - Lucia [translated from Spanish]

This is consistent with the other chapters in this dissertation, which show that emotional support even when delivered at great distances can buffer stress for pregnant Latina women. Additionally, women described the strategic benefits of geographic distance to avoid family pressures (e.g., *"Because she's not here* [mother-in-law living in Mexico], *I don't feel pressure that I have to listen to what she says"*). These findings suggest that alloparental care is more nuanced than previously

thought, and that geographic distance may not hinder mothers' access to emotional or informational alloparental support.

4.2.4 Conflicting Advice and Cultural Context of Intergenerational Knowledge Transfers

New parents often rely on knowledge and practices passed down from their own parents and cultural communities when navigating pregnancy, childbirth, and infant care (Belsky et al., 2009; Kerr & Capaldi, 2019). These interactions can be influenced by cultural norms, family dynamics, and the quality of relationships between generations (Ross et al., 2005; Swartz, 2009). Yet, there are open questions of how processes of acculturation influence the transmission of perinatal knowledge and parenting practices among immigrant families. Specifically, what role do immigration experiences, cultural adaptation, and exposure to host country norms and healthcare systems play in shaping intergenerational dynamics around perinatal care?

> "So, **the advice I'm receiving from a pediatrician is American, but the advice I received from my parents is Mexican. I mean, it's very different.** So it's frustrating sometimes because I understand that what they [my parents] have done has worked for them. But we also --and I don't want to discard my culture. **I love my culture and I believe in a lot of the stuff we do. I also feel like I can't disregard you know, American culture and just the things that they do that do work.** Yeah, so I would say sometimes, like when she [my baby] gets sick, and they [my parents] try to help me, it's not welcomed because I feel frustrated. I feel like I can do it on my own, but like, I just kind of feel like they need to mind their business and let me take care of my own house…[But] **I just didn't want them to think of it like I don't value their opinion, because I do, no matter like how frustrating it is sometimes. I do always take into consideration what they say and what they do. And most of the time, I end up doing like a variation of what they are telling me, what my baby's pediatrician is telling me, and [whoever] else has an opinion.**" - Gabriela

> "If I'm telling her [my mom] '*Oh, look at the study*', she just won't read it. *'I want you to read the study because after you read the study, you'll realize that you shouldn't do this.'* But if I see her continually doing the thing, I'll realize, '*Oh, she didn't even bother reading the study.'* So, then I have to explain to her and then **she'll think that I'm kind of telling her how to be a mother even though she already did that. I'm like, '*Damn, I don't want to tell my mom how to be a mom'* because she's done it already. But at the same time, what I know is different than what she's known. She wasn't educated the way that I'm educated now. She didn't come here to give me a better life so that I could just not know more than she does.** I think I do, because that's the kind of life she gave me. I was more educated. So now I can apply those things to my daughter and not do the same as her." - Paloma

These quotes highlight the interplay between cultural beliefs, generational differences, and evolving medical knowledge in parenting practices. Many participants grapple with a desire to honor their cultural heritage, while also utilizing contemporary scientific understanding when it comes to raising their children. Simultaneously, 1.5/2nd generation women often encounter diametrically opposed pressures from family: to achieve academically/professionally, so that the stress of immigrating to and living in America was 'worth it' for the immigrant parents, and to become a mother and follow the normative cultural traditions. This is described as a paradox by other researchers, who highlight that Latina mothers often want to satisfy their family on both of these opposing goals (Montano et al., 2023). This tension between generations is foregrounded by immigration experiences, which puts a distinct boundary between parents and their adult children. These issues are cultural, but can affect health through impacting reproductive choices.

There is an evolutionary mismatch consideration to make here as well since modern cultural environments create changes in the birthing information much faster than the turnover of biological generations. When traditional knowledge transmission pathways are disrupted by faster changing medical knowledge, many women seem to try to blend the disparate streams of knowledge they receive into a new singular framework that works for them. This active construction of their own framework for parenting and other perinatal practices harkens back to the future-oriented perspective some women shared about their biculturalism (e.g., "*We're questioning everything. So it's very unique in that we're not stuck to the ways of America, you know?*" / "*I understand [Mexican culture], but I don't have to abide by it. I don't have to practice it. I don't have to live by it.*"). Additionally, the agency women take in actively restructuring the streams of information they receive into new reproductive choices that are tailored to them can be harnessed in health care. These issues are helpful to consider when promoting evidence-based

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information to a diverse population, who may have other cultural needs (like honoring their family's wishes), rather than just receiving the most up-to-date perinatal information.

4.3 Social Support: How Not Asking for Help Can be an Act of Care

Social support is critical to health. Yet, many cultural, interpersonal, and structural barriers exist. In this chapter, I reflect deeply on the barriers to social support that manifest as *"I didn't ask for help."* Here is a clear example of how the overwhelming stress of motherhood without social support can lead to depression and other negative affective states:

> "The baby [when he was younger] collects 100% of my time, you know? Like, so my house was a mess. And I didn't have anything to eat, you know, like, there were times that I was just drinking like, a cup of juice and like, I guess that's like the easiest like one minute thing to do, you know? …I think the fact that like **I didn't want to seem like I couldn't handle it myself. So, I didn't ever call for help, saying '*can you come in and help me do my chores? Can you just [watch the baby] for an hour so I can clean this, you know, or wash clothes or*'**— so that I think that took a toll on me eventually. Because there were times where I did break down obviously, **I never told anybody you know, like, emotionally breaking down with the baby in the sofa crying, you know? Like, I'm hungry. I can't put him down because he would wake up."** - Elena

This heartbreaking experience is unfortunately very common in the U.S., as many women do not get the care and support they need during the critical first 6-weeks postpartum (Finlayson et al., 2020; Sacks & Langlois, 2016). In the questionnaire, I asked "*Do you feel like you are getting the support you need right now?*" specifically about emotional, informational, instrumental, and financial support (Table 5.1). Elena answered "Yes" to all of the questionnaire items. Granted, at the time of the interview her baby was the oldest of the cohort (1 year old). But this seems to be a common trend: women will voice needs in interviews, but are less likely to describe dissatisfaction with social support from family. Elena also ranked the people that help her most as 1 - Mom, 2- Mother-in-law, 3 - Husband, 4 - Sisters, 5- Sister-in-Law. Women were instructed to leave the chart blank if they did not feel supported. Therefore, Elena reported 100% satisfaction with all forms of social support and a strong support network on the questionnaire, but also in the interview

that she was emotionally breaking down because of the burdens of motherhood and overwhelmed to the point that she did not have time to take care of her needs. These apparent inconsistencies warrant further exploration.

In another example, Gabriela depicts a strong, caring family network at the same time as verbalizing a need of more support:

> "Yeah I mean, **she's my first child and she is my parent's first grandchild. So, there's like a lot of attention on her**, she has everybody's attention. **But it gets hard when we are at home by ourselves** because she wants to be held all the time or she wants someone to constantly be sitting with her and that's like that's hard to do because there's things around the house that need to get done and you know **there is only so much help people can give me**, like, especially my family. Yeah, so like yeah, that's a little stressful sometimes. " - Gabriela

Most women described both (a) needing more support (with some women needing *a lot* more support) and (b) that help was always freely offered by their family members to the point that they did not have to ask:

> "I would say that for most Mexican families, it's not that you have to ask, they kind of just offer and just come and do it. So, they would just like say, *'Hey, want me to come over today?'* And they would come and do it, no questions asked." - Adriana

> "I would say his [husband's] family offer too. I know his mom always offered to help. She's like, *'if you need anything, let me know.'* But I never really asked because I get so much help already. And I'm not really the type of person to ask. They just kind of offer so I just kind of take the help." - Kristina

> "It's usually freely offered." - Raquel

> "I mean, I feel like just, that's something my mom has shown us, you know, we try to be helpful. So, like I said, we're very family oriented. So, I feel like that has definitely helped, in the sense that we're always trying to help each other and providing like support in any way that we can." - Jessica

Due to the fact that help was culturally expected to be offered, many women found it difficult to ask for *more* help when needed:

> "Well yes, one hopes not to have to ask. Like for example now that I've already gone through this [parturition recovery and motherhood]. Now I know how I can help a mother and the things I didn't dare ask for, but if they had told me *'I'll do this'*, I wouldn't have said no. I would have accepted it if they had offered. But if they are not offered. I didn't feel I could ask" - Lucia [translated from Spanish]

As shown in Table 2, I asked women to share their feelings about stereotypical findings from the literature in order to gauge a baseline of their opinions and open up wider conversations about these topics. People are not usually cognizant of the cultural or evolutionary reasons behind what they do (Richerson & Boyd, 2008). However, the ethos of these questions was to treat women as community researchers in order to start a conversation that centered on helping other women during their postpartum experience. Thus, it seemed reasonable to ask opinions on these statements given that they are widely shared in the literature.

My interlocutors universally agreed with the idea that Latinos tend to have 'close-knit' families compared to other groups. Specifically, they all endorsed (without naming it) the cultural ideal of *familismo,* which refers to a strong sense of loyalty, reciprocity, and interconnectedness within the family unit (Campos et al., 2008). Family ties are often considered paramount in Latino cultures, and individuals may feel a deep sense of obligation to support and care for their family members, often prioritizing the needs of the family over individual desires (Smith-Morris et al., 2013). Sabogal et al. quantified the *familismo* concept as centering on (1) family obligation, (2) perceived support from family, (3) deference in decisions to family (1987). As described in *Introduction: Anthropology Framing* section of this chapter, health research reduces cultures and beliefs into constructs usable in quantitative statistical tests, while anthropologists qualitatively seek out the complexity and variation within those beliefs and behaviors. In health research, *familismo* is a powerful construct strongly associated with more social support and less stress during pregnancy (Campos et al., 2008). In anthropological practice, *familismo* is described as an ideal aimed for by many, but does not always determine behavior (Smith-Morris et al., 2013).

In contrast, women did not unanimously agree about the third finding that women do not ask for help because it may cast them as *"a bad mom"* or that they *"can't handle motherhood."*

This statement comes from literature focusing on the cultural value of *marianismo*, which emphasizes the idealization of motherhood and self-sacrifice within Latina communities (Morales & Pérez, 2020). It suggests that Latinas may be reluctant to ask for help because seeking assistance could be perceived as a sign of weakness or inadequacy in fulfilling the traditional role of an "ideal" mother. Consequently, admitting the need for help might be seen as falling short of these expectations and could lead to feelings of guilt or shame (Lara-Cinisomo et al., 2018, 2019). The variance in opinion on agreeing with this idea may be due to the fact that women are not cognizing the reasons they do the things they do. However, women *were* verbalizing this feeling, such as in Elena's quote presented earlier ("*I didn't want to seem like I couldn't handle it myself*"). Additionally, women shared that they would not want to ask for help outside of family (which was the second stereotypical research finding):

> "Well, I always mostly, like, cared for myself at a young age, I always felt that I always had the potential to do everything myself. I never really like bothering others, or want them to think that I can't do something. … Being close to family, they know how you are and **others from outside your family don't really know how you are. And you don't want to ask just anybody for help**." - Raquel

> "My mom always taught us to be very private about our problems, you know, like, not everybody needs to know what's going on with you. I don't know if that's a good thing or not a good thing. I've been told by a lot of people that I need to open up more. So, I'm not very good at asking for help, personally." - Gabriela

Women also acknowledged that there are cultural values that impact how mothers are viewed and should act:

> "Traditionally, Mexicans do have that mentality where motherhood should come natural to you due to the notion that this is what women are supposed to do." - Adriana *(the end of this quote is included after the next paragraph)*

> "...we [Mexicans] do have this thing where we try to show to the world or to anybody outside of our house [that] everything is okay, that [we] have no problems that you know, our life is perfect. …I can recall my godmother, you know, always making those comments like or saying that phrase like '*dirty laundry, you do that at home*'. … **it's something that limits us to ask for**, like, **help in general, whether it can be like mental health or, you know, emotional support, or stuff like that, I guess we're kind of expected to be strong and to like, have everything under control**." - Jessica

The fact that some women endorsed feelings of guilt or embarrassment associated with asking for help as a sign of maternal incompetence, while others did not endorse those feelings supports the idea that these cultural values around motherhood are *part* of the story of not asking for help, but it is not the *whole* story.

Here, I take a feminist and anthropological perspective to emphasize the agency and negotiation involved in family relationships. Critics of the academic use of *marianismo* suggest that this cultural value may not accurately reflect the realities of women's lives today, particularly as societies evolve and women's roles change (Navarro, 2002). While cultural values such as *familismo* and *marianismo* may shape familial roles and expectations, individuals within families actively interpret and negotiate these values in their daily lives. This perspective highlights the dynamic nature of cultural values and the role of individual agency in shaping social practices. This is pretty clearly laid out by Paloma, who states:

> "**I don't think anything gets in my way of asking for help.** I try to do things myself but **I'm not really like shamed into not asking for help.** My family is supportive and we fight but they're really supportive. **I don't feel like I'm pulled one way or the other by my culture. I try not to let culture make my decisions for me."** -Paloma

Who in the same interview also stated:

> "I always feel bad asking my mom for help all the time. I thought, well, not everyone has their mom to help them. So I felt like I shouldn't be having to ask my mom for help all the time" - Paloma:

These quotes from Paloma show an acknowledgement of cultural reasons to not ask for help (shame/stigma), and suggests that her reasons to not ask for help may be more likely motivated by family relationships.

In the example previously shared about cultural values of motherhood, Adriana goes on to describe how her biculturalism affords her flexibility to be comfortable reaching out to her mom for help:

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"Traditionally, **Mexicans do have that mentality where motherhood should come natural to you due to the notion that this is what women are supposed to do.** But I think **being Mexican-American, I think that I'm more comfortable reaching out to my mom and asking for help, whereas maybe she [my mother] wouldn't have been as comfortable asking her mom to come help her do this or do that…I would say that for most Mexican families, it's not that you have to ask, they kind of just offer and just come and do it.** So, they would just like say, '*Hey, want me to come over today?*' And they would come and do it. No questions asked." – Adriana

It appears that there is a strong cultural value around not asking for help, and instead it is culturally normative to freely offer help often (e.g., *"for most Mexican families, it's not that you have to ask, they kind of just offer and just come and do it"*). For many women, the difficulty came in asking for **more** help (e.g., *"One hopes not to have to ask. … I didn't dare ask for [help], but if they had told me 'I'll do this', I wouldn't have said no…if they did not offer, I didn't feel I could ask"*). However, some women seemed to have an easier time asking than others (*"I don't think anything gets in my way of asking for help. I try to do things myself, but I'm not really like shamed into not asking for help."*) Future research could more explicitly, or even quantitatively, explore acculturation and the reluctance to request different forms of social support from close members of their social networks.

Cultural values shape societal narratives about women, but sometimes the analysis of these cultural values in the literature can frame women as passive recipients of external forces rather than active agents in their own lives. In these interviews, women *did* express guilt or shame regarding their perceived inadequacy in managing motherhood, reflecting the influence of cultural values in shaping their responses. However, not asking for help should not only be seen through the lens of maternal competency, but rather as a reflection of a woman's autonomy to define her own needs and preferences in caregiving. In this context, not asking for help can be an act of care in itself, aligning more with *familismo* and obligation to care for one's family. Women themselves adopted a more proactive stance when discussing their reluctance to seek assistance. They

articulated concerns about adding to the burdens of their already overstretched families, indicating

an agentive choice surrounding social support mobilization:

> "It's a little harder for me to ask, like, '*Hey, can you transfer him to this while I go do this?*' You know? ... **I feel like asking for additional help is like <u>taking advantage,</u> you know, their generosity. So, it is harder for me to ask for help.** … They offer it like when I mentioned '*Oh, yeah, I really need to go to Costco…*' But um, but yeah, it's harder for me just because of the fact that they already are taking care of them from Monday to Thursday." - Elena

> "It's **already having her [my mom] do a favor for me to even help me watch the baby or clean the house, but having her drive all the way out here, I feel as though maybe I should be paying her.** It's just a little embarrassing to have her drive all the way out here to help me do basic things." – Adriana

These women do have guilt, but for most women it does not seem to center around appearing like

they cannot handle the burden of motherhood. Rather, the guilt is often in asking for *more* from

their social network who women describe as already offering so much.

This is a critical difference to understand because if there is stigma surrounding

motherhood ideals there may be motivation to create public policy that coaches women in

American-values of asking for what you need and not feeling guilty about needing help. Often

recommendations include suggesting culturally-tailored interventions that promote social support

and provide education about available resources that help mitigate barriers to help-seeking (e.g.,

Negron et al., 2013, who suggest interventions that encourage and educate on the importance of

partner/family social support). Here is an example of such a public health recommendation derived

from a qualitative project with first-time mothers:

> "Recommendations for clinical practice include the necessity for nurses and midwives **to emphasise the importance of family, particularly their partner and own mothers as providers of social support in the postnatal period. Furthermore, nurses and midwives need to understand the concept of social support and empower mothers to mobilise support**." (Leahy-Warren et al., 2012; p. 395).

These can be helpful practices for new mothers. However, I do not think that women are not aware

of the importance of social support, nor ignorant of how to mobilize support. Instead, women are

performing acts of care for their own families, which does not necessarily need to be changed. Instead, women themselves said they need support in resources (e.g., how to find free diapers or someone to call from the hospital to check in on them). Their insights underscore the necessity for systemic changes to provide meaningful assistance rather than simply promoting new modes of help-seeking that put the onus for improving health outcomes on the individual.

Research interested in creating translational care for postpartum women should shift focus away from individual-level recommendations, and rather towards addressing structural issues of care. While personal resilience is important, expecting patients to navigate systemic challenges on their own is unrealistic and often exacerbates feelings of isolation and stress. Structural problems such as inadequate healthcare infrastructure, limited access to affordable childcare, and insufficient parental leave policies create barriers that cannot be overcome through individual effort alone. By recognizing and addressing these systemic barriers, interventions can create a more supportive environment for new parents, ensuring that everyone has equitable access to the resources and assistance they need during the postpartum period.

5. Conclusions

The women sharing their stories in this chapter describe the dynamic nature of their Mexican-American identities. Often women felt stressed from the conflicting advice and pressure from family/society, but also from feeling misunderstood by their parents. However, women also felt empowered by their bicultural identities, which afforded them unique opportunities in motherhood to create their own path that works for them and is the 'best of both worlds'.

While mothers valued the benefits of having family nearby, they also described effective emotional support across borders and strategic benefits of geographic distance to mitigate family pressures. These findings suggest that alloparental care is nuanced, and geographic distance may

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not hinder access to emotional and informational support. Recommendations include investing in communication infrastructure to facilitate these forms of social support across geographic space. Women also described the intimate relationships with their own mothers despite harsher/blunter exchanges surrounding childcare and social support compared to that from mothers-in-law. This supports some of the differences between maternal and paternal grandmother effects described in other chapters.

Despite the stated importance of and need for social support in these interviews, these women often did not ask their families for help. Cultural expectations of self-sacrifice and stigma surrounding mental health issues seem to be part of the story, but not the whole story. Women received a lot of help from family without asking for it; but in response, it became difficult to ask for *more* help when needed it due to an understanding that their networks were already trying to help them. I suggest that not asking for help can be an act of care in itself. Women are choosing to not overburden their family members by asking for more help, but they will take it when freely offered. Women themselves call for practical and structural resources like free diapers and check-ins from the hospital. Instead of solely emphasizing individual efforts, we must address systemic barriers to truly assist new parents.

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Chapter 6: Conclusion

There is a critical need to understand the biopsychosocial pathways that underlie the perinatal health trends that are currently worsening in the U.S. These trends include growing rates of maternal mortality, preeclampsia, low birth weight, preterm birth, and perinatal depression for all age and ethnic groups (Chen et al., 2022; Dwarakanath et al., 2023; Fleszar et al., 2023; Yocom, 2022). While the COVID-19 pandemic definitively increased economic and psychological distress as well as interrupted social support networks at a global scale, these worsening health trends started well before and exist outside of COVID-related problems. Additionally, both socioeconomic and health issues disproportionately affect minority communities living in the U.S. (Fleszar et al., 2023). Latinos are experiencing distinct and worsening stressors (such as acculturation, discrimination, and food insecurity), as well as disproportionately high rates of psychological distress both during and outside of pregnancy (González, 2020; Hswen et al., 2020; Huang et al., 2007; Krogstad & Lopez, 2020; U.S. Census Bureau, 2021). Thus, it is crucial to examine both the embodiment of stressors as a biological process and the resilience systems that buffer against stress, in order to interrupt cycles of minority health disparities.

In this dissertation, I present a comprehensive exploration of the biopsychosocial disparities in Latina maternal-fetal health, drawing on an interdisciplinary framework that integrates cultural anthropology, evolutionary biology, and health sciences. I employ a multifaceted approach to investigate the intricate interplay between psychosocial stressors, resilience systems of social support, and maternal mental health outcomes among Latina women in Southern California. Through three distinct aims (Table 6.1), this dissertation adds to the growing literature on the sociocultural and interpersonal factors that shape maternal wellbeing.

Table 6.1: Dissertation Aims

Aim 1	Evaluate the associations of maternal psychosocial stress and a novel biomarker of placental stress	Explored in Chapter 2
Aim 2	Assess the influence of grandmothers on prenatal maternal psychology	Explored in Chapter 3 and 4
Aim 3	Explore the intergenerational transmission of stress, social support, and reproductive knowledge among first-time mothers.	Explored in Chapter 5 and frames the entire dissertation

1. Aim 1

The first aim addresses a major gap in stress embodiment research: the mechanism. In **Chapter 2**, I utilize state-of-the-art nanomolecular immuno-affinity assays to explore the relationship between maternal psychological distress and placental activity. To better comprehend the immediate mechanisms behind stress exposure during pregnancy on fetal development, it is crucial to directly study placental alterations. The placenta serves as the conduit through which all biological material and information are exchanged between the mother and fetus. Understanding the changes that occur in the placenta during periods of maternal stress can provide valuable insights into the mechanisms underlying fetal stress exposure. However, the placenta is exceptionally challenging to study due to the vulnerability of the fetus during gestation.

With plasma samples from 41 women, I find in **Chapter 2** that increased psychological distress reduces the release of HLA-G+ placental extracellular vesicles (EVs). EVs are small membrane-bound structures released by cells into the external environment (Doyle & Wang, 2019). EVs play an important role in intercellular communication by transferring various molecules such as proteins, nucleic acids (i.e., RNA and DNA), and lipids between cells (Doyle & Wang, 2019). Placental trophoblasts, which are cells that form the outer layer of the placenta, are known to produce and release EVs into maternal circulation, and serve as mediators of

information exchanged between the mother and the developing fetus (Tong & Chamley, 2015). By releasing EVs into maternal circulation, the placenta may facilitate bidirectional communication. Changes in the composition or quantity of EVs released by placental trophoblasts may indicate alterations in placental function or fetal health. The findings in Chapter 2 that a reduction in the release of EVs, as observed in response to maternal psychological distress, suggests a potential disruption in the communication between the maternal immune system and the developing fetus.

Overall, EVs derived from placental trophoblasts play a crucial role in facilitating maternal-fetal communication by transferring important biological information between the mother and the fetus. While the consequences of this finding (i.e., low placental EVs in response to psychological distress during pregnancy) are unknown, we can speculate from an evolutionary perspective that there may be a maternal advantage to diminishing the biochemical communication the mother receives from the feto-placenta unit. Understanding the dynamics of these vesicles and their contents can provide valuable insights into the mechanisms underlying pregnancy-related complications and may contribute to the development of diagnostic and therapeutic strategies to support maternal and fetal health.

2. Aim 2

The relationship of stress during pregnancy and postnatal offspring health outcomes are described by the framework of developmental origins of health and disease (DOHaD). Evolutionary anthropology studies have illustrated that humans require a lot of help rearing offspring. Additionally, particular helpers (or allomothers) may assist mothers as it would increase the former's inclusive fitness. Much work on allomaternal inclusive fitness has described how these individuals reduce (or exacerbate) infant mortality rates, particularly offspring survival past

weaning (e.g, Sear & Mace, 2008). However, there are many other vulnerable periods for both mother and offspring during the perinatal period, including breastfeeding (which is difficult to learn to do; Scelza & Hinde, 2019), childbirth, and pregnancy. The increasing risk to offspring health, via DOHaD, during pregnancy indicates that allomothers may adaptively benefit from upregulating help during pregnancy in addition to postnatal allocare. Aim 2 explores the role of grandmothers in improving maternal wellbeing and offspring fitness outcomes from an evolutionary perspective.

To explore this concept, I analyzed various aspects of the relationship between expectant mothers and grandmothers in **Chapter 3** using data from 216 pregnant women who took part in Wave 1 of the Mothers' Cultural Experiences Project. My findings indicate that communication and emotional support from maternal grandmothers significantly reduce maternal depression. Considering the link between depression during pregnancy and infant morbidity and mortality (Callaghan et al., 2006; Eshete et al., 2019) as well as long-term health issues for offspring (Glynn et al., 2018; Glynn & Sandman, 2011; Kinsella & Monk, 2009; Leis et al., 2014), this could represent an adaptive strategy of grandmothers to enhance the overall fitness of the offspring as well as their own inclusive fitness.

Chapter 4 builds upon the research questions posed in Chapter 3 by investigating whether these prenatal effects from grandmothers serve as explicit buffers against stress. Using the same cohort from Wave 1 of the Mothers' Cultural Experiences Project, I examine whether any of these relationship characteristics moderate the detrimental impact of discrimination on mental health. First, I confirm previous literature findings that discrimination correlates with worsened maternal mental health, showing significant positive associations with depression, anxiety, and stress in linear regression models. Subsequently, I demonstrate that communication and emotional support

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from maternal grandmothers mitigate the psychological distress experienced by pregnant women. This chapter underscores a crucial avenue of resilience during pregnancy against psychosocial stressors such as discrimination. Taken together, Chapters 3 and 4 employ quantitative methods—utilizing validated scales in self-report questionnaires and multiple-linear regression models—to substantiate the presence of a prenatal allomaternal effect. This finding contributes to evolutionary literature and minority health research by suggesting that grandmothers may serve to interrupt the detrimental effects of maternal depression on fetal outcomes, thereby enhancing our understanding of intergenerational reproductive strategies and possible resilience factors against stressors like discrimination.

Both findings in Chapter 3 and 4 were significant for maternal grandmothers and not paternal grandmothers, after adjusting for the influence of father support/relationship factors. The lack of significant findings regarding paternal grandmothers could stem from potentially smaller effect sizes. Alternatively, this outcome may align with a prevailing trend in research indicating that maternal grandmaternal investment holds greater strength. This heightened investment could be attributed to the direct bond with her daughter, resulting in an additional boost in resources aimed at supporting both her immediate offspring and potential future generations. These latter points were highlighted in Chapter 5, where women report an intensified relationship with their own mothers during pregnancy, which can manifest as being taken care of as if they are an infant again.

3. Aim 3

Aim 3 of this dissertation seeks to provide insights into the intergenerational transmission of stress, social support, and reproductive knowledge among first-time mothers, focusing particularly on the experiences of 1.5 and 2nd generation Mexican-American women. In Chapter

5, I present person-centered interviews (reviewed with a systematic content-analysis methodology) that explore bicultural stress, intergenerational caregiving dynamics, and the mobilization of social support among first-time mothers. This chapter underscores the influence of cultural values and societal expectations on help-seeking behaviors among Mexican-American women. While navigating conflicting advice and societal pressures, alongside the challenge of feeling misunderstood by their parents, these women forged a unique path in motherhood that harmonizes cultural heritage and personal autonomy. This highlights the resilience in their experiences.

Moreover, while proximity to family offers tangible benefits (such as readily available instrumental assistance), the women interviewed in Chapter 5 also described advantages in geographic distance to mitigate familial pressures. This finding challenges conventional notions regarding the impact of geographic distance on support networks, and suggests a more nuanced function of alloparental care in that geographic distance does not necessarily hinder access to much needed emotional support. This merges well with the findings of Chapters 3 and 4, which show emotional support and communication, but not geographic proximity, buffer stress and improve psychological wellbeing. All three chapters highlight the importance of investing in communication infrastructure to facilitate emotional support across geographic space. Jointly, Chapter 3-5 elucidate the nuanced dynamics of familial investment strategies during pregnancy through exploring the evolutionary and cultural underpinnings of intergenerational support systems.

Despite recognizing the importance of social support, the women interviewed in Chapter 5 described facing barriers in seeking help. Particularly, women reported much freely offered social support from their loved ones due to shared cultural values to help mothers as much as possible. However, this rendered requesting additional help as much more challenging. In this chapter, I

reframe the reluctance of these women to seek help as an expression of cultural values emphasizing familial care rather than a reflection of their self-stigmatization of an inability to handle motherhood. The women sharing their stories in Chapter 5 advocate for practical resources, emphasizing the need for structural interventions to alleviate the challenges faced by new parents. Therefore, interventions should prioritize structural reforms and concrete resources over solely targeting individual education or initiatives. By acknowledging the complexities inherent in navigating cultural expectations and familial dynamics, the U.S. can strive towards implementing more holistic approaches to support new parents, addressing both individual needs and systemic barriers.

4. Significance

This dissertation contributes significantly to health equity research by addressing key gaps in understanding the biological, psychosocial, and cultural factors influencing maternal-fetal health disparities among Latina groups. Through a comprehensive interdisciplinary approach, the following contributions emerge: Firstly, by investigating the proximate mechanisms through which stress impacts birth outcomes, this dissertation addresses a critical gap in understanding how maternal stress affects placental biology. Aim 1 evaluates the associations between maternal anxiety/depression and placental stress biomarkers, offering a potential biological pathway underlying adverse birth outcomes. Secondly, the exploration of prenatal investment from allomothers, not just postpartum allocare, fills another important gap in the literature. By reframing obstetric outcomes as risks to offspring quality that other family members should be motivated to minimize for inclusive fitness benefits, this dissertation bridges the gap between developmental origins of health and disease and evolutionary theory. It expands the cooperative breeding literature by examining the prenatal period, an understudied aspect in allomother literature.

Thirdly, I add to perinatal health research by exploring the understudied experiences of the 1.5 generation and the cultural milieu surrounding social support. Furthermore, I investigate the underutilization of social support among Mexican-American first-time mothers and describe a novel cultural barrier to asking for help. By contributing to the understanding of the sociocultural context within which Latina mothers navigate support systems, interventions can be tailored to address these barriers and promote equitable access to care.

Collectively, these chapters contribute to a richer understanding of maternal psychological distress, embodiment, and resilience during the perinatal period among Latina mothers. By integrating qualitative, psychometric, and biological data, as well as state-of-the-art biomedical technologies, this research offers a comprehensive approach to studying maternal-fetal health disparities. Ultimately, the unifying goal of this interdisciplinary dissertation is to understand and address biopsychosocial disparities in Latina maternal-fetal health. By assessing etiological factors involved in mental health and obstetric disparities among Latina populations and identifying interpersonal stress buffers, this research contributes to advancing health equity and improving maternal-fetal outcomes in diverse communities.

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