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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.

Keywords

Grandmothers; Allomothers; Social support; Perinatal mental health; Latina; Inclusive fitness

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Declaration of Competing Interest

None.

Appendix A. Supplementary data

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

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 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 more consistently 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 sociocultural 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 α = 0.81, English α = 0.84, Spanish α = 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 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 heteroscedasticity 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.

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 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.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Anderson KG (2006). How well does paternity confidence match actual paternity? Evidence from worldwide nonpaternity rates. Current Anthropology, 47(3), 513–520. 10.1086/504167

Barnett MA, Mills-Koonce WR, Gustafsson H, Cox M, & Investigators FLPK (2012). Mother-grandmother conflict, negative parenting, and young Children's social development in multigenerational families. Family Relations, 61(5), 864–877. 10.1111/j.1741-3729.2012.00731.x

Bateson M, Brilot B, & Nettle D. (2011). Anxiety: An evolutionary approach. The Canadian Journal of Psychiatry, 56(12), 707–715. 10.1177/070674371105601202 [PubMed: 22152639]

Bedaso A, Adams J, Peng W, & Sibbritt D. (2021). The relationship between social support and mental health problems during pregnancy: A systematic review and meta-analysis. Reproductive Health, 18(1), 162. 10.1186/s12978-021-01209-5 [PubMed: 34321040]

Berghella V, Boelig R, Roman A, Burd J, & Anderson K. (2020). Decreased incidence of preterm birth during coronavirus disease 2019 pandemic. American Journal of Obstetrics & Gynecology Mfm, 2(4), Article 100258. 10.1016/j.ajogmf.2020.100258

Bogin B, Bragg J, & Kuzawa C. (2014). Humans are not cooperative breeders but practice biocultural reproduction. Annals of Human Biology, 41(4), 368–380. 10.3109/03014460.2014.923938 [PubMed: 24932750]

Callaghan WM, MacDorman MF, Rasmussen SA, Qin C, & Lackritz EM (2006).The contribution of preterm birth to infant mortality rates in the United States. Pediatrics, 118(4), 1566–1573. 10.1542/peds.2006-0860 [PubMed: 17015548]

Campos B, Schetter CD, Abdou CM, Hobel CJ, Glynn LM, & Sandman CA (2008). Familialism, social support, and stress: Positive implications for pregnant Latinas. Cultural Diversity and Ethnic Minority Psychology, 14(2), 155–162. 10.1037/1099-9809.14.2.155 [PubMed: 18426288]

Cant MA, & Johnstone RA (2008). Reproductive conflict and the separation of reproductive generations in humans. Proceedings of the National Academy of Sciences, 105(14), 5332–5336. 10.1073/pnas.0711911105

CDC. (2019). Mental and Behavioral Health—Hispanics—The Office of Minority Health. https://minorityhealth.hhs.gov/omh/browse.aspx?lvl4&lvlid 69.

Chapman SN, Lahdenperä M, Pettay JE, Lynch RF, & Lummaa V. (2021). Offspring fertility and grandchild survival enhanced by maternal grandmothers in a pre-industrial human society. Scientific Reports, 11(1), 3652. 10.1038/s41598-021-83353-3 [PubMed: 33574488]

Chapman SN, Pettay JE, Lahdenperä M, & Lummaa V. (2018). Grandmotherhood across the demographic transition. PLoS One, 13(7), Article e0200963. 10.1371/journal.pone.0200963

Coall DA, & Hertwig R. (2010). Grandparental investment: Past, present, and future. Behavioral and Brain Sciences, 33(1), 1–19. 10.1017/S0140525X09991105 [PubMed: 20377929]

Coall DA, & Hertwig R. (2011). Grandparental investment: A relic of the past or a resource for the future? Current Directions in Psychological Science, 20(2), 93–98. 10.1177/0963721411403269

Cohn D, & Passel JS (2018). Record 64 million Americans live in multigenerational households. PEW Research Center. https://www.pewresearch.org/fact-tank/2018/04/05/a-record-64-million-americans-live-in-multigenerational-households/.

Collins NL, Dunkel-Schetter C, Lobel M, & Scrimshaw SC (1993). Social support in pregnancy: Psychosocial correlates of birth outcomes and postpartum depression. Journal of Personality and Social Psychology, 65(6), 1243–1258. 10.1037/0022-3514.65.6.1243 [PubMed: 8295121]

Cox JL, Holden JM, & Sagovsky R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. The British Journal of Psychiatry: the Journal of Mental Science, 150, 782–786. 10.1192/bjp.150.6.782 [PubMed: 3651732]

Crittenden AN, & Marlowe FW (2008). Allomaternal care among the Hadza of Tanzania. Human Nature, 19(3), 249–262. 10.1007/s12110-008-9043-3 [PubMed: 26181616]

Dunkel Schetter C, & Brooks K. (2009). The nature of social support. In Reis HT, & Sprecher S. (Eds.), Encyclopedia of human relationships (pp. 1565–1570). Sage Publications.

Dunkel Schetter C, & Tanner L. (2012). Anxiety, depression and stress in pregnancy: Implications for mothers, children, research, and practice. Current Opinion in Psychiatry, 25(2), 141–148. 10.1097/YCO.0b013e3283503680 [PubMed: 22262028]

Edwards LM (2004). Measuring perceived social support in Mexican American youth: Psychometric properties of the multidimensional scale of perceived social support. Hispanic Journal of Behavioral Sciences, 26(2), 187–194. 10.1177/0739986304264374

Elsenbruch S, Benson S, Rücke M, Rose M, Dudenhausen J, Pincus-Knackstedt MK, … Arck PC (2007). Social support during pregnancy: Effects on maternal depressive symptoms, smoking and pregnancy outcome. Human Reproduction, 22(3), 869–877. 10.1093/humrep/del432 [PubMed: 17110400]

Emmott EH, & Mace R. (2015). Practical support from fathers and grandmothers is associated with lower levels of breastfeeding in the UK millennium cohort study. PLoS One, 10(7), Article e0133547. 10.1371/journal.pone.0133547

Emmott EH, Myers S, & Page AE (2021). Who cares for women with children? Crossing the bridge between disciplines. Philosophical Transactions of the Royal Society B: Biological Sciences, 376(1827), 20200019. 10.1098/rstb.2020.0019

Engelhardt SC, Bergeron P, Gagnon A, Dillon L, & Pelletier F. (2019). Using geographic distance as a potential proxy for help in the assessment of the grandmother hypothesis. Current Biology, 29(4), 651–656.e3. 10.1016/j.cub.2019.01.027 [PubMed: 30744976]

Eshete A, Alemu A, & Zerfu TA (2019). Magnitude and risk of dying among low birth weight neonates in rural Ethiopia: A community-based cross-sectional study. International Journal Of Pediatrics, 2019, 9034952. 10.1155/2019/9034952

Feldman PJ, Dunkel-Schetter C, Sandman CA, & Wadhwa PD (2000). Maternal social support predicts birth weight and fetal growth in human pregnancy. Psychosomatic Medicine, 62(5), 715–725. 10.1097/00006842-200009000-00016 [PubMed: 11020102]

Fishell A. (2010). Depression and anxiety in pregnancy. Journal of Population Therapeutics and Clinical Pharmacology, 17(3). Article 3 https://www.jptcp.com.

Fox M. (2021). Discrimination as a moderator of the effects of acculturation and cultural values on mental health among pregnant and postpartum Latina women. American Anthropologist, 123(4), 780–804. 10.1111/aman.13665 [PubMed: 36776224]

Freeman A, Tyrovolas S, Koyanagi A, Chatterji S, Leonardi M, Ayuso-Mateos JL, … Haro JM (2016). The role of socio-economic status in depression: Results from the COURAGE (aging survey in Europe). BMC Public Health, 16(1), 1098. 10.1186/s12889-016-3638-0 [PubMed: 27760538]

Glynn LM, Howland MA, Sandman CA, Davis EP, Phelan M, Baram TZ, & Stern HS (2018). Prenatal maternal mood patterns predict child temperament and adolescent mental health. Journal of Affective Disorders, 228, 83–90. 10.1016/j.jad.2017.11.065 [PubMed: 29241049]

Glynn LM, & Sandman CA (2011). Prenatal origins of neurological development: A critical period for fetus and mother. Current Directions in Psychological Science, 20(6), 384–389. 10.1177/0963721411422056

Grigoriadis S, Graves L, Peer M, Mamisashvili L, Tomlinson G, Vigod SN, … Richter M. (2018). Maternal anxiety during pregnancy and the association with adverse perinatal outcomes: systematic review and meta-analysis. The Journal of Clinical Psychiatry, 79(5), 0. 10.4088/JCP.17r12011

Grigoriadis S, VonderPorten EH, Mamisashvili L, Tomlinson G, Dennis C-L, Koren G, … Radford K. (2013). The impact of maternal depression during pregnancy on perinatal outcomes: A systematic review and Meta-analysis. The Journal of Clinical Psychiatry, 74(4), 0. 10.4088/JCP.12r07968

Grote NK, Bridge JA, Gavin AR, Melville JL, Iyengar S, & Katon WJ (2010). A Meta-analysis of depression during pregnancy and the risk of preterm birth, low birth weight, and intrauterine growth restriction. Archives of General Psychiatry, 67 (10), 1012–1024. 10.1001/archgenpsychiatry.2010.111 [PubMed: 20921117]

Hagen EH (2002). Depression as bargaining: The case postpartum. Evolution and Human Behavior, 23(5), 323–336. 10.1016/S1090-5138(01)00102-7

Haig D. (2015). Maternal–fetal conflict, genomic imprinting and mammalian vulnerabilities to cancer. Philosophical Transactions of the Royal Society B: Biological Sciences, 370(1673), 20140178. 10.1098/rstb.2014.0178

Hawkes K, O'Connell JF, Jones NGB, Alvarez H, & Charnov EL (1998). Grandmothering, menopause, and the evolution of human life histories. Proceedings of the National Academy of Sciences, 95(3), 1336–1339. 10.1073/pnas.95.3.1336

Hirschfeld RMA (2001). The comorbidity of major depression and anxiety disorders: recognition and management in primary care. Primary Care Companion to The Journal of Clinical Psychiatry, 3(6), 244–254.

Hrdy SB (2005). Cooperative breeders with an ace in the hole. In Voland E, Chasiotis A, & Schiefenhövel W. (Eds.), Grandmotherhood: The evolutionary significance of the second half of female life. Rutgers University Press.

Johnston R, Jones K, & Manley D. (2018). Confounding and collinearity in regression analysis: A cautionary tale and an alternative procedure, illustrated by studies of British voting behaviour. Quality & Quantity, 52(4), 1957–1976. 10.1007/s11135-017-0584-6 [PubMed: 29937587]

Kana'Iaupuni SM, Donato KM, Thompson-Colón T, & Stainback M. (2005). Counting on kin: Social networks, social support, and child health status. Social Forces, 83(3), 1137–1164.

Kee MZL, Ponmudi S, Phua DY, Rifkin-Graboi A, Chong YS, Tan KH, … Meaney MJ (2021). Preconception origins of perinatal maternal mental health. Archives of Women's Mental Health, 24(4), 605–618. 10.1007/s00737-020-01096-y

Kinsella MT, & Monk C. (2009). Impact of maternal stress, Depression & Anxiety on fetal neurobehavioral development. Clinical Obstetrics and Gynecology, 52(3), 425–440. 10.1097/GRF.0b013e3181b52df1 [PubMed: 19661759]

Kramer KL (2005). Children's help and the pace of reproduction: Cooperative breeding in humans. Evolutionary Anthropology: Issues, News, and Reviews, 14(6), 224–237. 10.1002/evan.20082

Kramer KL (2010). Cooperative breeding and its significance to the demographic success of humans. Annual Review of Anthropology, 39(1), 417–436. 10.1146/annurev.anthro.012809.105054

Leis JA, Heron J, Stuart EA, & Mendelson T. (2014). Associations between maternal mental health and child emotional and behavioral problems: Does prenatal mental health matter? Journal of Abnormal Child Psychology, 42(1), 161–171. 10.1007/s10802-013-9766-4 [PubMed: 23748337]

Leonetti D, Nath D, Heman N, & Niell D. (2005). Kinship organization and the impact of grandmothers on reproductive success among the matrilineal Khasi and patrilineal Bengali of

Northeast India. In Voland E, Chasiotis A, & Schiefenhövel W. (Eds.), Grandmotherhood: The evolutionary significance of the second half of female life. Rutgers University Press.

March of Dimes. (2015). Issue in brief: Stress and pregnancy. https://www.marchofdimes.org/materials/Maternal-Stress-Issue-Brief-January2015.pdf.

McBurney DH, Simon J, Gaulin SJC, & Geliebter A. (2002). Matrilateral biases in the investment of aunts and uncles: Replication in a population presumed to have high paternity certainty. Human Nature (Hawthorne, N.Y.), 13(3), 391–402. 10.1007/s12110-002-1022-5

Meehan CL, Helfrecht C, & Quinlan RJ (2014). Cooperative breeding and Aka children's nutritional status: Is flexibility key?: Cooperative breeding and Aka nutritional status. American Journal of Physical Anthropology, 153(4), 513–525. 10.1002/ajpa.22415 [PubMed: 24452414]

Menard S. (2002). Applied logistic regression analysis. SAGE Publications, Inc.. 10.4135/9781412983433

Morelli SA, Lee IA, Arnn ME, & Zaki J. (2015). Emotional and instrumental support provision interact to predict well-being. Emotion (Washington, D.C.), 15(4), 484–493. 10.1037/emo0000084 [PubMed: 26098734]

Myers S, Burger O, & Johns SE (2016). Postnatal depression and reproductive success in modern, low-fertility contexts. Evolution, Medicine, and Public Health, 2016 (1), 71–84. 10.1093/emph/eow003 [PubMed: 26976787]

Myers S, Page AE, & Emmott EH (2021). The differential role of practical and emotional support in infant feeding experience in the UK. Philosophical Transactions of the Royal Society B: Biological Sciences, 376(1827). 10.1098/rstb.2020.0034.rstb.2020.0034, 20200034.

Nesse RM (2019). Good reasons for bad feelings: Insights from the frontier of evolutionary psychiatry. Dutton.

Nettle D, & Bateson M. (2012). The evolutionary origins of mood and its disorders. Current Biology, 22(17), R712–R721. 10.1016/j.cub.2012.06.020 [PubMed: 22975002]

Nuñez A, González P, Talavera GA, Sanchez-Johnsen L, Roesch SC, Davis Sonia M, … Gallo LC (2016). Machismo, Marianismo, and negative cognitive- emotional factors: Findings from the Hispanic community health study/study of Latinos sociocultural ancillary study. Journal of Latina/o Psychology, 4(4), 202–217. 10.1037/lat0000050 [PubMed: 27840779]

Pashos A. (2017). Asymmetric caregiving by grandparents, aunts, and uncles and the theories of kin selection and paternity certainty: How does evolution explain human behavior toward close relatives? Cross-Cultural Research, 51(3), 263–284. 10.1177/1069397117697671

Pearson RM, Evans J, Kounali D, Lewis G, Heron J, Ramchandani PG, … Stein A. (2013). Maternal depression during pregnancy and the postnatal period: Risks and possible mechanisms for offspring depression at age 18 years. JAMA Psychiatry, 70(12), 1312–1319. 10.1001/jamapsychiatry.2013.2163 [PubMed: 24108418]

Peccei J. (2005). Menopause: Adaptation and epiphenomenon. In Voland E, Chasiotis A, & Schiefenhövel W. (Eds.), Grandmotherhood: The evolutionary significance of the second half of female life. Rutgers University Press.

Perry G, & Daly M. (2017). A model explaining the matrilateral bias in alloparental investment. Proceedings of the National Academy of Sciences, 114(35), 9290–9295. 10.1073/pnas.1705910114

PEW Research Center. (2010). The return of the multi-generational family household. https://www.pewresearch.org/social-trends/2010/03/18/the-return-of-the-multi-generational-family-household/.

PEW Research Center. (2020). Key findings about U.S. immigrants. https://www.pewresearch.org/fact-tank/2020/08/20/key-findings-about-u-s-immigrants/.

Ponting C, Mahrer NE, Zelcer H, Dunkel Schetter C, & Chavira DA (2020). Psychological interventions for depression and anxiety in pregnant Latina and black women in the United States: A systematic review. Clinical Psychology & Psychotherapy, 27(2), 249–265. 10.1002/cpp.2424 [PubMed: 31960525]

Prall SP, & Scelza BA (2020). Why men invest in non-biological offspring: Paternal care and paternity confidence among Himba pastoralists. Proceedings of the Royal Society B: Biological Sciences, 287(1922), 20192890. 10.1098/rspb.2019.2890

Reblin M, & Uchino BN (2008). Social and emotional support and its implication for health. Current Opinion in Psychiatry, 21(2), 201–205. 10.1097/YCO.0b013e3282f3ad89 [PubMed: 18332671]

Rini CK, Dunkel-Schetter C, Wadhwa PD, & Sandman CA (1999). Psychological adaptation and birth outcomes: The role of personal resources, stress, and sociocultural context in pregnancy. Health Psychology, 18(4), 333–345. 10.1037//0278-6133.18.4.333 [PubMed: 10431934]

Rosenberg K, & Trevathan W. (2002). Birth, obstetrics and human evolution. BJOG: An International Journal of Obstetrics & Gynaecology, 109(11), 1199–1206. 10.1046/j.1471-0528.2002.00010.x [PubMed: 12452455]

Santos IS, Matijasevich A, Tavares BF, Barros AJD, Botelho IP, Lapolli C, … Barros FC (2007). Validation of the Edinburgh postnatal depression scale (EPDS) in a sample of mothers from the 2004 Pelotas birth cohort study. Cadernos de Saúde Pública, 23(11), 2577–2588. 10.1590/S0102-311X2007001100005 [PubMed: 17952250]

Scelza BA (2009). The grandmaternal niche: Critical caretaking among Martu aborigines. American Journal of Human Biology, 21(4), 448–454. 10.1002/ajhb.20934 [PubMed: 19402034]

Scelza BA (2011). The place of proximity. Human Nature, 22(1), 108–127. 10.1007/s12110-011-9112-x [PubMed: 22388803]

Scelza BA, & Hinde K. (2019). Crucial contributions: A biocultural study of Grandmothering during the perinatal period. Human Nature, 30(4), 371–397. 10.1007/s12110-019-09356-2 [PubMed: 31802396]

Sear R. (2016). Beyond the nuclear family: An evolutionary perspective on parenting. Current Opinion in Psychology, 7, 98–103. 10.1016/j.copsyc.2015.08.013

Sear R. (2018). Family and fertility: Does kin help influence women's fertility, and how does this vary worldwide? Population Horizons, 14(1), 18–34. 10.1515/pophzn-2017-0006

Sear R. (2021). The male breadwinner nuclear family is not the 'traditional' human family, and promotion of this myth may have adverse health consequences. Philosophical Transactions of the Royal Society B: Biological Sciences, 376(1827). 10.1098/rstb.2020.0020

Sear R, & Mace R. (2008). Who keeps children alive? A review of the effects of kin on child survival. Evolution and Human Behavior, 29(1), 1–18. 10.1016/j.evolhumbehav.2007.10.001

Seguin L, Potvin L, Stdenis M, & Loiselle J. (1995). Chronic stressors, social support, and depression during pregnancy. Obstetrics & Gynecology, 85(4), 583–589. 10.1016/0029-7844(94)00449-N [PubMed: 7898838]

Strassmann BI, & Garrard WM (2011). Alternatives to the grandmother hypothesis: A Meta-analysis of the association between grandparental and grandchild survival in patrilineal populations. Human Nature, 22(1–2), 201–222. 10.1007/s12110-011-9114-8 [PubMed: 22388808]

Suls JM, & Wallston KA (Eds.). (2003). Social psychological foundations of health and illness. Blackwell Pub.

Tluczek A, Henriques JB, & Brown RL (2009). Support for the reliability and validity of a six-item state anxiety scale derived from the state-trait anxiety inventory. Journal of Nursing Measurement, 17(1), 19–28. 10.1891/1061-3749.17.1.19 [PubMed: 19902657]

Trivers RL (1972). Parental Investment and Sexual Selection. 22.

Vega W, Kolody B, Valle R, & Weir J. (1991). Social networks, social support, and their relationship to depression among immigrant Mexican women. Human Organization, 50(2), 154–162. 10.17730/humo.50.2.p340266397214724

Wadhwa PD, Sandman CA, Porto M, Dunkel-Schetter C, & Garite TJ (1993). The association between prenatal stress and infant birth weight and gestational age at birth: A prospective investigation. American Journal of Obstetrics and Gynecology, 169(4), 858–865. 10.1016/0002-9378(93)90016-C [PubMed: 8238139]

Williams KE, Marsh WK, & Rasgon NL (2007). Mood disorders and fertility in women: A critical review of the literature and implications for future research. Human Reproduction Update, 13(6), 607–616. 10.1093/humupd/dmm019 [PubMed: 17895237]

Zimet GD, Dahlem NW, Zimet SG, & Farley GK (1988). The multidimensional scale of perceived social support. Journal of Personality Assessment, 52(1), 30–41. 10.1207/s15327752jpa5201_2

Zimet GD, Powell SS, Farley GK, Werkman S, & Berkoff KA (1990). Psychometric characteristics of the multidimensional scale of perceived social support. Journal of Personality Assessment, 55(3–4), 610–617. 10.1080/00223891.1990.9674095 [PubMed: 2280326]

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%)

	Total (N = 216)
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%)
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%)

	Total (N = 216)
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%)

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).