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Parental attachment anxiety: Associations with allostatic load in mothers of 1-year-olds

Kharah M. Ross[1], Heidi S. Kane[2], Christine Guardino[3], and Christine Dunkel Schetter[1]

Abstract

Growing evidence indicates that individual differences in attachment style are related to health outcomes. The present study extends this literature by examining whether attachment anxiety in both mothers and fathers predicts maternal health the year following the birth of a child in a sample of 698 low-income, racially diverse couples. We hypothesized that maternal perceptions of partner responsiveness would mediate these associations. Maternal allostatic load, a measure of cumulative wear-and-tear on the body due to stress, was used as an indicator of maternal health. Maternal biomarkers (blood pressure, adiposity, blood metabolites, inflammation, and diurnal cortisol) were scored using clinical or top-quartile cutoffs to compute an allostatic load index. Attachment anxiety and perceived partner responsiveness were assessed in interviews. Path models were used to test indirect associations between mother and father attachment anxiety and maternal allostatic load through perceived partner responsiveness. We found that higher mother and father attachment anxiety were each independently and indirectly associated with higher maternal allostatic load through lower maternal perceptions of partner responsiveness. These findings highlight the need to consider both relationship and partner factors in understanding maternal health.

[1] University of California – Los Angeles, USA
[2] The University of Texas at Dallas, USA
[3] Dickinson College, USA

Corresponding author:
Kharah M. Ross, Department of Psychology, University of California – Los Angeles, 502 Portola Plaza 1285 Franz Hall, Los Angeles, CA 90095, USA.
Email: kharah.ross@ucalgary.ca

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The year after a birth can be personally and interpersonally challenging for new and experienced mothers due to many stressors, including physical recovery from parturition, caregiving demands of an infant, sleep deficits, and changes in one's intimate relationships and social network (Belsky & Pensky, 1988; Cowan & Cowan, 2000; Medina, Lederhos, & Lillis, 2009). For many couples, this is a time of relationship strain, with less time spent alone together and a decline in relationship quality (Medina et al., 2009). The ability to cope with these challenges and adapt to these changes is critical to maternal health, not only during the period following a birth but also long term (e.g., Shannon, King, & Kennedy, 2007).

Adult attachment theory provides a useful framework for understanding how interpersonal processes in couple relationships are related to navigating the changes and challenges during the year after birth because individual differences in adult romantic attachment play a role in coping, regulating stress responses, support seeking and provision, and relationship functioning (e.g., Pietromonaco, DeBuse, & Powers, 2013; Simpson & Rholes, 2008; Wilson, Rholes, Simpson, & Tran, 2007). Given the interdependence of couples' relationships (Kelley & Thibaut, 1978), it is important to consider the individual differences in adult romantic attachment of *both* parents as they may influence maternal health outcomes during this time period. The dyadic model proposed by Pietromonaco, Uchino, and Dunkel Schetter (2013) specifies the contribution of individual differences in adult romantic attachment of both couple members to each person's health outcomes and mediating interpersonal processes. Thus, the purpose of the present study was to test whether maternal and paternal attachment anxiety were associated with concurrent maternal health, as indicated by allostatic load one year after the birth of a child, and to test if maternal perceptions of partner responsiveness explained these associations.

Attachment anxiety and the year following birth

The attachment system is an innate behavioral system that promotes feelings of safety and security, especially during times of threat or difficulty, by regulating proximity to attachment figures, such as early caregivers and adult romantic partners. Individual differences in adult romantic attachment may develop when romantic partners are unresponsive or inconsistently responsive to these regulatory needs (e.g., Mikulincer & Shaver, 2008; Mikulincer, Shaver, & Pereg, 2003), and are conceptualized along two continuous dimensions: *attachment avoidance* and *attachment anxiety*. In the present study, only attachment anxiety was assessed due to constraints imposed by the larger research study. As a community participatory study conducted in collaboration with community leaders, special consideration was given to reducing participant burden. Attachment anxiety was included in the study because it is emerging as a consistent predictor of health-related outcomes, whereas attachment avoidance is a less-consistent predictor (e.g., Carmichael & Reis, 2005; Stanton & Campbell, 2014).

Attachment anxiety is characterized by a fear of abandonment by a romantic partner, rejection, and being unloved and the use of hyperactivating strategies to regulate safety and security, such as excessive proximity and reassurance seeking (Mikulincer & Shaver, 2008). Individuals high in attachment anxiety are hypervigilant to their partner's behavior for cues of their love and concern. They have heightened arousal, difficulty with emotion regulation, tend to use emotion-focused coping or rumination strategies that can heighten negative affect, and tend to perceive ambiguous (but potentially negative) situations as relationship threatening (e.g., Brennan, Clark, & Shaver, 1998; Collins & Feeney, 2000; Mikulincer & Shaver, 2008; Shaver & Mikulincer, 2002). Thus, coping with the challenges during the year after birth may be particularly difficult for mothers high in attachment anxiety (Berant, Mikulincer, & Florian, 2001; Rholes et al., 2011). Furthermore, these difficulties may also extend to mothers with *partners* high in attachment anxiety due to their partners extra reassurance seeking (Shaver, Schachner, & Mikulincer, 2005), need for help coping and regulating emotions, and less effective support provision to others (Collins & Feeney, 2000).

Attachment anxiety and allostatic load

The concepts of allostasis and allostatic load provide a useful framework for understanding the effects of stress on maternal health (Ramey et al., 2015; Shannon et al., 2007). During times of stress, allostasis is the physiological process of maintaining stability through change (e.g., McEwen, 1998). Specifically, when faced with threat or challenge, physiological changes occur within multiple systems (e.g., neuroendocrine, cardiovascular, immune) to meet the demands of the threat. After the threat has resolved, a return to a baseline occurs. Allostatic load represents the cumulative wear-and-tear on the body that occurs over time when the activation of these stress responsive systems is repeated or prolonged, causing multisystemic dysregulation. In support of this theory, allostatic load measures predict a number of health outcomes, including mortality, declines in physical and cognitive function, and incidence of cardiovascular disease (e.g., Seeman, Singer, Rowe, Horwitz, & McEwen, 1997).

Only a few studies have shown that interpersonal experiences, such as perceived social support, predict allostatic load indices in the general population (e.g., Brooks et al., 2014). Within a maternal health context, higher perceived social support, as part of an index of psychosocial resources, was associated with lower concurrent allostatic load one year after the birth of a child in a larger sample of mothers from the present study (O'Campo et al., 2016). To our knowledge, no studies have examined the relations between one's own attachment anxiety, one's partner's attachment anxiety and allostatic load in the general population, or with respect to maternal health.

However, a growing body of evidence supports the hypothesis that attachment anxiety is likely associated with allostatic load (Robles & Kane, 2014; Stanton & Campbell, 2014). First, extensive research indicates that higher attachment anxiety is related to greater physiological reactivity to stressors, both relational types (e.g., relationship conflict) and nonrelational types (e.g., laboratory speech task) (e.g., Brooks, Robles, & Dunkel Schetter, 2011; Dewitte, De Houwer, Goubert, & Buysse, 2010; Diamond, Hicks, & Otter-Henderson, 2008; Ditzen et al., 2008; Gallo & Matthews, 2006; Kidd, Hamer, & Steptoe, 2011; Meuwly et al., 2012; Powers, Pietromonaco, Gunlicks, & Sayer, 2006; Quirin, Pruessner, & Kuhl, 2008). We note that this literature is limited in that findings are most consistent among men for relational stressors, inconsistent for nonrelational stressors, and largely limited to cortisol responses. Theoretically, however, heightened physiological responses to stressors contribute to greater wear-and-tear on the body and higher allostatic load. Second, higher attachment anxiety is related to indicators of poorer steady state (i.e., not in response to a specific stressor) physiological functioning, which are indicative of allostatic load, such as dysregulated immune functioning (e.g., Fagundes et al., 2014) and diurnal cortisol (Quirin et al., 2008). Taken together, these findings provide a basis for predicting that attachment anxiety in mothers should predict higher maternal allostatic load.

Whether one's partner's attachment anxiety is directly related to a mother's allostatic load has not been addressed. A few studies have examined the effects of attachment anxiety on a partner's stress reactivity (e.g., Brooks et al., 2014; Powers et al., 2006). For example, one study showed that men with insecure female partners (including high attachment anxiety) had increased cortisol reactivity to a threatening conflict task, but this pattern was not apparent for women (Powers et al., 2006). Another study of couples found that women showed greater cortisol reactivity to interpersonal threatening discussions with men high in attachment avoidance but not with men high in attachment anxiety (Brooks et al., 2014). Thus, the present investigation will significantly contribute to this growing literature by examining the relationship between a *partner's* attachment anxiety and a broad, multisystemic indicator of health, that is, allostatic load, in a large sample of mothers.

Perceived partner responsiveness

Perceived partner responsiveness is defined as the beliefs that (a) one is valued and respected by his or her romantic partner; (b) one's romantic partner understands one's needs, strengths, wants, and weaknesses; and (c) one feels cared for by his or her romantic partner based on expressions of affection, concern for one's well-being, and sensitivity to one's needs (e.g., Feeney & Collins, 2015; Reis & Gable, 2015). As such, perceived partner responsiveness is a key factor in the development of trust, intimacy, and relationship satisfaction in close relationships (Gable, Gosnell, Maisel, & Strachman, 2012; Laurenceau, Barrett, & Rovine, 2005). Perceived partner responsiveness is also associated with personal well-being and health (Feeney & Collins, 2015; Reis & Gable, 2015). In a nationally representative sample, perceived partner responsiveness predicted better regulated diurnal cortisol profiles (Slatcher, Selcuk, & Ong, 2015), better sleep quality (Selcuk, Stanton, Slatcher, & Ong, 2016), and reduced mortality risk (Stanton, Selcuk, Farrell, Slatcher, & Ong, 2019).

Attachment anxiety plays a role in shaping perceptions of support through several mechanisms. People high in attachment anxiety tend to perceive their partners as poor support providers who are less responsive and available, and they perceive the absence of support or low-quality of support as particularly distressing and hurtful (Collins & Feeney, 2004; Davila & Kashy, 2009; Kane et al., 2007). These perceptions are due, in part, to negatively biased interpretations of partner behavior and negatively biased memories of partner behavior (Collins & Feeney, 2004; Mikulincer, Sarason, Sarason, & Shaver, 2009). However, these perceptions are also due in part to actual negative partner behavior (e.g., Mikulincer et al., 2009).

During the changes and adaptations of caring for an infant, mothers may be in particular need of comfort, support, and understanding in interacting with their partner. However, partners who themselves are taxed and in need of support may not have the capacity, motivation, or ability to be responsive or provide the highest quality of care (Ford & Collins, 2010). This suboptimal situation is exacerbated for mothers with partners higher in attachment anxiety. People high in attachment anxiety are less likely to provide responsive and sensitive support that matches the needs of their partner (Davila & Kashy, 2009; Feeney & Collins, 2001), in part due to their difficulty regulating their own distress. Thus, both a mother's own attachment anxiety and her partner's attachment anxiety shape maternal perceptions of partner responsiveness.

Diverse and low-income populations

Finally, the majority of the existing research on attachment anxiety and health has focused on samples of affluent/educated and/or White individuals (Berant et al., 2001; Brooks et al., 2011; Dewitte et al., 2010; Diamond et al., 2008; Fagundes et al., 2014; Gouin et al., 2009; Powers et al., 2006). Much less is known about attachment and health in traditionally underrepresented low-income and ethnically/racially diverse samples. Close relationship quality and social network composition can vary by race/ethnicity and socioeconomic status (e.g., Jackson, Kennedy, Bradbury, & Karney, 2014; Jackson, Krull, Bradbury, & Karney, 2017). Black/Latina and lower socioeconomic status individuals are more likely to be affected by social stressors (e.g., Cundiff, Birmingham, Uchino, & Smith, 2016; Cundiff & Smith, 2017; Cundiff, Smith, Baron, & Uchino, 2016) and are disproportionately burdened by disease and poor health (American Psychological Association Working Group on Stress and Health Disparities, 2017). Understanding the close relationship factors, such as attachment anxiety and perceived partner responsiveness, that contribute to early indicators of disease risk, in this case to allostatic load, in low socioeconomic status and diverse samples is therefore particularly valuable.

Present study

In the present study, we based hypotheses on the model proposed by Pietromonaco et al. (2013) and existing research. Specifically, we predict that both mother and father attachment anxiety will be directly associated with an index of maternal allostatic load 12 months after the birth of a child, and indirectly associated with maternal allostatic load via mother's perceptions of perceived partner responsiveness. We tested these hypotheses in a sample of diverse, low-income parents. At 12 months after a child's birth, mothers and fathers completed a measure of attachment anxiety, mothers completed a measure of perceived partner responsiveness, and maternal biomarkers were measured to operationalize allostatic load.

Method

Participants

The sample consisted of 698 ethnically/racially diverse, low-income women and their partners (mother–father dyads) recruited by the Community Child and Health Network

(CCHN) study, funded by the Eunice Kennedy Shriver National Institute for Child Health and Human Development. Women were recruited immediately following the birth of a child in one of five sites: Los Angeles, CA; Washington, DC; Baltimore, MD; Lake County, IL; and rural eastern North Carolina. Study sites were selected based on epidemiological evidence of maternal and child health disparities and population characteristics reflective of a high proportion of low income and racial/ethnic minority groups with high morbidities. Eligibility criteria were 18–40 years old; self-identification as White, Black or Latina; English or Spanish-speaking; residence in target zip codes for at least 6 months; currently having four or fewer children; and no intention to be surgically sterilized after the current birth. The baby's fathers were also invited to participate. Additional information on participant recruitment protocols is published elsewhere (BeLue et al., 2014). Participants provided informed consent, and all study procedures and protocols were reviewed and approved by the institutional review boards of all community and academic institutions associated with CCHN (Ramey et al., 2015).

Procedure

The CCHN study design consisted of three structured, in-home interviews with mothers and separately with fathers at 1 month, 6 months, and 12 month postpartum. Attachment anxiety and perceived partner responsiveness were measured at 12 months postpartum. At the same time, a total of 12 maternal biomarkers were obtained for calculating a total of 10 allostatic load indicators. These biomarkers consisted of resting systolic blood pressure (SBP) and diastolic blood pressure (DBP); heart rate (HR); waist and hip circumference, height and weight; cholesterol (total and high-density lipoprotein [HDL]); C-reactive protein (CRP) and glycosylated hemoglobin obtained from dried blood spots (DBS); and diurnal cortisol obtained from saliva samples collected following the in-home interviews. Demographic and medical covariates were also assessed. Of the original 2,448 women enrolled in CCHN, 1,795 completed a 12-month postpartum assessment. Of those, 698 mother–father dyads provided data on key variables, that is, mother and father attachment anxiety and maternal allostatic load. Compared to participants who were excluded due to missing data on key variables, participants included in this sample were older at study entry, $t(1{,}793) = -5.92, p < .001$, ($M_{\text{included}} = 26.9$ years, $SD_{\text{included}} = 5.81$ years; $Mn_{\text{excluded}} = 25.3$ years, $SD_{\text{excluded}} = 5.67$ years), had higher adjusted per capita household income, $t(1727) = -3.67, p < .001$, ($Mn_{\text{included}} =$ US\$14,214, $SD_{\text{included}} =$ US\$21, 687; $Mn_{\text{excluded}} =$ US\$10,821, $SD_{\text{excluded}} =$ \$16,713), were less likely to be Black, $\chi^2(2) = 122, p < .001$ (excluded: 62% Black, 21% Latina, 16% White), and were more likely to be married or cohabiting, $\chi^2(2) = 172, p < .001$ (excluded: 22% cohabiting or married). Sample characteristics are presented in Table 1.

Attachment anxiety

A shortened 3-item version of the Adult Attachment Scale (AAS) was used in this study (Collins & Read, 1990). Donnellan, Burt, Levendosky, and Klump (2008) conducted a principal-axis exploratory factor analysis on the 18 AAS items to select items that loaded high on the anxiety factor (>.60) but low on the avoidance factor (<.35) in an effort to

Table 1. Sample characteristics (N = 698).

Variable	Mothers	Fathers
Anxious attachment, *M* (*SD*)	5.43 (2.90)	5.36 (2.80)
Partner responsiveness, *M* (*SD*)	52.1 (10.3)	NA
Age (years), M (SD)	28.1 (5.84)	31.0 (7.24)
Race/ethnicity, *n* (%)		
Black	253 (36)	258 (37)
Latina	211 (30)	202 (29)
White	234 (34)	209 (30)
Other[a]	NA	30 (4)
Adjusted per capita household income ($), *M* (*SD*)	14,215 (21,687)	15,594 (19,576)
Breastfeeding, n (%)		
Currently	12 (84)	NA
Breastfed but stopped	54 (377)	NA
Never	19 (3)	NA
Cohabiting/married, *n* (%)	573 (82)	
Parity (primiparous), *n* (%)	293 (42)	
Medication use (yes), *n* (%)	87 (15)	
Allostatic load (clinical cutoffs), *M* (*SD*)	2.81 (1.90)	

[a]Mother inclusion criteria included self-identification as Black, Latina, or White, but no restrictions existed for their partner.

obtain relatively distinct indicators of attachment anxiety. This approach produced a 5-item attachment anxiety scale with good convergent validity with other measures of attachment anxiety (Donnellan, Burt, Levendosky, & Klump, 2008), including the widely used Experiences in Close Relationships Questionnaire–Revised (Fraley, Waller, & Brennan, 2000). Because of space constraints and priorities of the community collaborators, three of these items were selected for inclusion in the study. The 3 items were "I often worry that my partner does not really love me," "I often worry that my partner will not want to stay with me," and "I often worry whether my partner really cares about me." Responses for each item ranged from "strongly disagree" (1) to "strongly agree" (5). Total attachment anxiety was calculated by summing the 3 items, with possible range from 3 to 15, and higher scores indicating greater attachment anxiety. The 3 items had good reliability for both mothers ($\alpha_{\text{mother}} = .88$) and fathers ($\alpha_{\text{father}} = .89$). Attachment anxiety scores were log base-10 transformed due to positively skewed distributions for both mothers and fathers. Mother and father attachment anxiety were correlated, $r = .356$.

Allostatic load

Study personnel obtained biophysical measures to calculate 10 maternal allostatic load biomarkers during at-home interviews at 12 months postpartum. They were body mass index (BMI), waist–hip ratio (WHR), SBP and DBP, HR, CRP, glycosylated hemoglobin, HDL cholesterol, total cholesterol to HDL ratio, and salivary cortisol diurnal slope.

WHR and BMI. Waist circumference at the navel and hip circumference at the widest part of the buttocks were measured using a cloth measuring tape and recorded to the nearest centimeter. Both measurements were then repeated and the average of the two measurements was used. WHR was calculated by dividing the waist measurement by the hip measurement. Participant weight and height were also measured. BMI (kg/m^2) was calculated by dividing weight by height squared.

Blood pressure. Blood pressure was taken three times using a portable, automatic blood pressure machine (HEM-711DLX or HEM-907XL Pro blood pressure monitor; OMRON, Kyoto, Japan). Resting SBP and DBP, in mmHg, and HR, in beats/min, were calculated by taking the average across the three measures.

Glycosylated hemoglobin and cholesterol. A nonfasting blood sample was collected using a DBS card. A finger was lanced, and capillary blood was collected on the filter paper. DBS cards were allowed to dry for 30 min and then stored at −30°C prior to shipment to ZRT Laboratory (Beaverton, Oregon, USA) for analysis. DBS were assayed for glycosylated hemoglobin, total cholesterol, HDL, and CRP. Glycosylated hemoglobin can be used as a proxy for fasting blood glucose and represents average red blood cell exposure to glucose over the previous 3 months. Percentage of glycosylated hemoglobin out of total hemoglobin is assessed using an immunoturbidimetric assay, coefficients of variation (CVs) < 8.5. Both nonfasting total cholesterol and HDL (mmol/L) were assessed via enzymatic assay, CVs < 7.1 and 8.7, respectively. A ratio of total cholesterol to HDL was calculated by dividing the total cholesterol values by the total HDL values, with higher values indicating greater cardiovascular disease risk (Millan et al., 2009). High-sensitivity CRP was assessed using enzyme immunoassay, CVs < 7.9.

Cortisol. Following in-house visits, saliva samples were collected at wake-up and before bedtime over 2 consecutive days. Participants were shown how to collect saliva samples using a passive drool method during the in-home visit. Time of sample collection was recorded on home saliva collection diaries. Completed saliva samples and diaries were mailed back to each research site and stored at −30°C until shipped to ZRT Laboratory. Cortisol was then assayed in saliva samples using an enzyme-linked immunoassay technique, CV < 8.0. Values greater than 1.8 were winsorized to 1.8 μg/dL. Cortisol slope was calculated by dividing the difference between the morning and evening cortisol values by hours between the morning and the evening measurements.

Allostatic load index. To calculate the allostatic load index, clinical cutoffs were determined for 9 of the 10 allostatic load biomarkers (O'Campo et al., 2016): BMI > 30 kg/m^2, WHR > 0.94, SBP > 120 mmHg, DBP > 80 mmHg, HR > 91 beats/min, CRP > 3 mg/L, glycosylated hemoglobin > 5.4%, HDL < 40 mg/dL, and total cholesterol to HDL ratio > 5.9. A quartile approach was used to define cutoffs for diurnal cortisol, for which no clinical cutoffs are available: Cortisol slope > −0.01 μg/dL/h.[1] Binary variables for each biomarker were calculated, with participants coded as being above the clinical cutoff (1) or at or below the clinical cutoff (0). Allostatic load scores were only calculated for participants with data available for the majority (≥70%)[2] of the biomarkers to avoid excessive imputation of missing data (Schafer & Graham, 2002). The procedure used in CCHN was to sum the number of thresholds met across the 10 biomarkers. To account for any missing data values, an algebraic correction was applied. Specifically, allostatic load scores were adjusted for missing data by multiplying by $10/k$, where k is the number of nonmissing biomarkers (Shalowitz et al., 2019). Allostatic load scores ranged from 0 to 10, with higher scores indicating greater allostatic load (O'Campo et al., 2016).

Perceived partner responsiveness

Mothers' perceptions of perceived partner responsiveness were measured at 12 months postpartum using the Perceived Partner Responsiveness Scale (Reis, Crasta, Rogge, Maniaci, & Carmichael, 2018). This instrument consists of self-report items assessing the extent to which the partner understands, listens to, values, and knows the respondent. In the CCHN study, 9 items from the original 18-item scale were administered to reduce participant burden. These items were selected based on face validity. Response options were from "not at all true/never true" (1) to "very true/true all the time" (7). The items showed good reliability ($\alpha = .93$). Partner responsiveness scores for mothers were obtained by summing across items and range from 9 to 63, with higher scores indicating greater partner responsiveness. A square root transformation was used on the perceived partner responsiveness scores due to a negatively skewed distribution.

Covariates

Covariates were maternal age, adjusted per capita household income, race/ethnicity, breastfeeding status, partner relationship status, and medication use. We also considered maternal employment status, parity, prepregnancy BMI, previous pregnancy complications, and oral contraceptive use as covariates but only included those that were significantly associated with either maternal allostatic load or the mediator, partner responsiveness.

Maternal age and race/ethnicity were obtained in interviews at study entry. Age was adjusted to be accurate for 1-year postpartum. Race/ethnicity was effect-coded into two variables with White as the reference group, *Latina ethnicity*: Latina (1), Black (0), and White (-1), and *Black race*: Latina (0), Black (1) and White (-1). At 1-month postpartum, mothers were asked to report their pretax household income over the past year using prespecified categories (e.g. US$10,000 to US$20,000 per year) and number of people living in the household. Per capita household income was calculated by dividing total household income (midpoint of category) by household size. Per capita household income was then adjusted for cost of living at each site using cost of living indices available from the US Census Bureau. Relationship status with partners was assessed at 12 months postpartum as reported by mothers. Relationship status was effect-coded as cohabiting or married, that is, committed relationship or living together (1) or not married or cohabiting (-1).[3]

Women reported medication use at 6-month postpartum. If a participant reported taking medications that could affect any of the allostatic load indicators, for example,

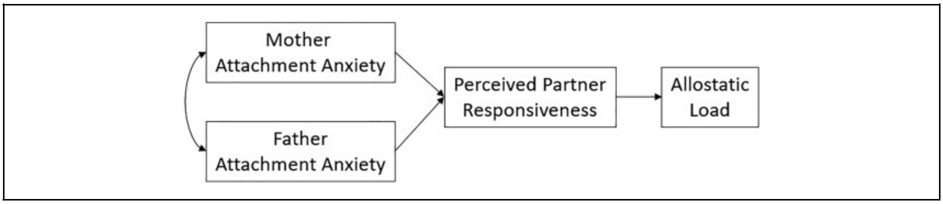

Figure 1. Conceptual model (based on a model produced by Pietromonaco et al., 2013).

steroids and non-steroidal anti-inflammatory drugs (NSAIDs), or that affect any diseases or conditions related to allostatic load indicators, for example, diabetes, blood pressure, chronic infections, asthma, allergies, or thyroid issues, they were coded as taking medications (1). All other women were coded as not taking medications (-1). Breastfeeding was assessed at 6 months postpartum, and women were coded as "stopped breastfeeding before 6 months postpartum" (-1) and "breastfed past 6 months postpartum" (1).

Analytic strategy

Analyses were run using SPSS v.24 (IBM Corp, 2013) and R v.3.1.2 (R Core Team, 2014). Data were inspected for outliers and normality prior to analyses. Outliers were defined as values greater than $\pm$ 3 *SD*s from the mean and were winsorized to $\pm$ 3 *SD*s, which was necessary for 1.1% of adjusted household income values only.

Bivariate associations among all study variables were calculated. Hypotheses were tested using multiple linear regression and structural equation model (SEM) with the R package *lavaan* (Rosseel, 2012), using full information maximum likelihood (FIML). FIML accounts for missing data by using information available from other variables and iterative optimization algorithms to estimate model parameters that maximize the sample log-likelihood (Enders, 2010). First, direct, independent associations between mother and father attachment anxiety and maternal allostatic load were tested using multiple linear regression models, both adjusted and not adjusted for covariates (maternal age, adjusted per capita household income, race/ethnicity, relationship status, breastfeeding and medication use).

Next, path analysis was conducted using SEM to test associations between mother and father attachment anxiety and maternal allostatic load, and mediation by mother's perceptions of partner responsiveness (Figure 1). The conceptual model in Figure 1 was translated into a SEM as follows: Mother and father attachment anxiety were exogenous predictor variables, mother perceptions of partner responsiveness was a mediating variable, and maternal allostatic load was the final outcome variable. To account for interdependence in couples, mother and father attachment anxiety were allowed to covary. Models were tested with and without covariates, and the same pattern of results emerged. As such, only covariate-adjusted models are presented. In covariate-adjusted models with 66 parameters and 698 mother–father dyads, we had a participants-to-parameters ratio of 10.6:1, which is adequate for reliably estimating parameters and test statistics (Kline, 2005).

Table 2. Summary of linear regression models predicting maternal allostatic load at 12 months postpartum from mother and father attachment anxiety, also assessed at 12 months postpartum, adjusted for covariates.

Variable	*b*	*SE*	*β*	*p*	95% CI
Age	.028	.014	.087	.044	[0.001, 0.056]
Adjusted per capita household income	−.004	.003	−.046	.245	[−0.011, 0.003]
Latina ethnicity[a]	.298	.098	.144	.002	[0.107, 0.490]
Black race[a]	.410	.095	.207	<.001	[0.223, 0.597]
Relationship status	−.180	.098	−.072	.066	[−0.372, 0.012]
Breastfeeding	−.352	.084	−.173	<.001	[−.0518, −0.187]
Medication use	.278	.108	.104	.010	[0.066, 0.490]
Mother attachment anxiety	.501	.359	.055	.163	[−0.203, 1.21]
Father attachment anxiety	.549	.364	.059	.131	[−0.164, 1.26]

Note. $N = 698$. *SE* = standard error; CI = confidence interval.
[a]Effects coded with White as the reference group.

Model fit was assessed through joint consideration of the χ^2 statistic, the standardized root mean residual (SRMR), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). Model fit is considered acceptable when the χ^2 statistic is nonsignificant, SRMR is .05 or less, CFI .95 or greater, and/or the RMSEA is between .05 and .08 (Kline, 2005).

Results

Attachment anxiety and allostatic load

We first computed bivariate correlations between key variables (Online Supplemental Table 1). Multiple linear regression models tested direct, independent associations between mother attachment anxiety, father attachment anxiety, and maternal allostatic load, with and without covariates. First, in models without covariates, higher mother attachment anxiety was significantly associated with higher maternal allostatic load, $b = .805$, $SE = .367$, $\beta = .088$, $p = .028$, and higher father attachment anxiety was marginally associated with maternal allostatic load, $b = .713$, $SE = .371$, $\beta = .076$, $p = .055$. However, associations between mother and father attachment anxiety and maternal allostatic load became nonsignificant after adjusting for maternal age, adjusted per capita household income, race/ethnicity, relationship status, breastfeeding and medication use, *p*s > .131 (Table 2).

Attachment anxiety, partner responsiveness, and allostatic load

Next, SEM path models were used to examine indirect associations between mother and father attachment anxiety and maternal allostatic load, via responsiveness, adjusting for covariates (i.e., maternal age, adjusted per capita household income, race/ethnicity, relationship status, breastfeeding and medication use) with respect to both the mediator (responsiveness) and the outcome (maternal allostatic load). Goodness-of-fit indices suggested adequate model fit, $\chi^2(16, N = 698) = 87$, $p < .001$, SRMR = .06,

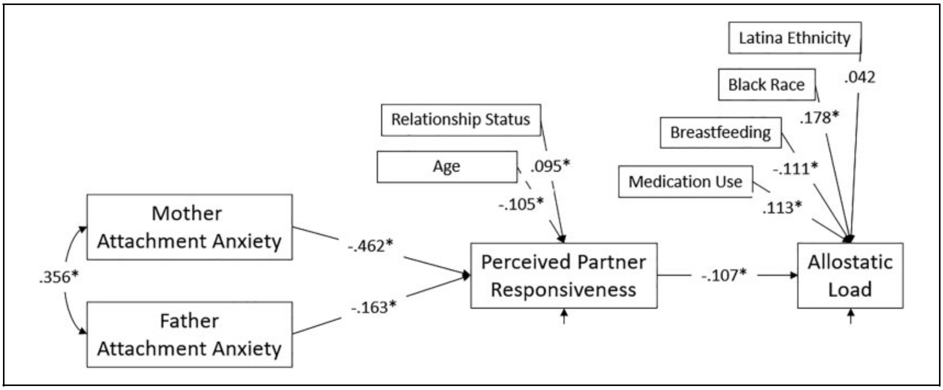

Figure 2. Standardized parameter estimate for the final model. Fit statistics for the model: $\chi^2(20, N = 698) = 92$, $p < .001$, SRMR = .05, CFI = .84, RMSEA = .07, $p = .007$. All predictor variables (including covariates) were allowed to covary, but for the sake of simplicity, only correlations between mother and father attachment anxiety are shown. Coefficients marked with a "*" are significant at $p < .05$. SRMR = standardized root mean residual; CFI = comparative fit index; RMSEA = root mean square error of approximation.

RMSEA = .08, $p = .002$.[4] Because the RMSEA for the null model was 0.147 (<0.158), the CFI is not reported (Kenny, 2015). To improve model fit, covariates with nonsignificant paths (i.e., maternal age, adjusted per capita household income, race/ethnicity, relationship status, breastfeeding and medication use) were removed from the model. After these nonsignificant paths were removed, goodness-of-fit indices improved, $\chi^2(20, N = 698) = 92$, $p < .001$, SRMR = .05, RMSEA = .07, $p = .007$. The final model is shown in Figure 2.

There was evidence of a significant indirect effect of perceived partner responsiveness linking mother attachment anxiety and maternal allostatic load at 12 months after the birth of a child (Table 3). Independent of father attachment anxiety, mothers with higher attachment anxiety tended to perceive their partners as less responsive, and perceptions of lower partner responsiveness were in turn associated with higher maternal allostatic load, $b = .448$, $SE = .160$, $\beta = .049$, $p = .005$. Additionally, there was evidence of a significant indirect effect of maternal perceptions of responsiveness linking father attachment anxiety and maternal allostatic load at 12 months after the birth of a child. Independent of their own attachment anxiety, mothers with partners (i.e. baby's father) higher in attachment anxiety tended to perceive their partners as less responsive, and perceptions of lower partner responsiveness were associated with higher maternal allostatic load, $b = .160$, $SE = .066$, $\beta = .017$, $p = .015$. These indirect paths remained significant when covariates were included in the model (see Figure 2).

In sum, at 12 months after the birth of a child, both mother and father attachment anxiety were independently and indirectly associated with maternal allostatic load via mother perceptions of partner responsiveness. Women who were high in attachment anxiety and/or who had partners high in attachment anxiety perceived their partners as less responsive, which in turn was associated with higher maternal allostatic load.

Table 3. Parameters from final, covariate adjusted models.

Outcome	Predictor	b	SE	β	p	95% CI
Responsiveness	Age	−0.014	.005	−.105	.002	[−0.024, −0.005]
	Relationship status	0.100	.036	.095	.006	[0.029, 0.170]
	Mother attachment anxiety	−1.78	.134	−.462	< .001	[−2.04, −1.52]
	Father attachment anxiety	−0.638	.136	−.163	< .001	[−0.904, −0.371]
Allostatic load	Latina ethnicity[a]	0.100	.102	.042	.331	[−0.101, 0.300]
	Black race[a]	0.404	.099	.178	< .001	[0.210, 0.597]
	Breastfeeding	−0.239	.088	−.111	.007	[−0.411, −0.067]
	Medication use	0.301	.110	.113	.006	[0.086, 0.516]
	Responsiveness	−0.251	.088	−.107	.004	[−0.424, −0.079]
Indirect effects	Mother attachment anxiety by responsiveness	0.448	.160	.049	.005	[0.133, 0.762]
	Father attachment anxiety by responsiveness	0.160	.066	.017	.015	[0.032, 0.289]

Note. $\chi^2(16, N = 698) = 86.5$, $p < .001$, SRMR = .056, CFI = .850, RMSEA = .079, $p = .002$. *SE* = standard error; CI = confidence interval; SRMR = standardized root mean residual; CFI = comparative fit index; RMSEA = root mean square error of approximation.
[a]Effects coded with White as the reference group.

Discussion

The attachment system plays a large role in the functioning of intimate partner relationships especially in the context of stress. During the year after the birth of child, when mothers navigate many physiological, psychological, and social changes, individual differences in a mother's attachment anxiety have implications for her mental and physical health. The purpose of this study was twofold. First, we tested whether attachment anxiety in parents was associated with an indicator of multisystem health—allostatic load—in mothers 12 months after the birth of a child. Second, we tested whether maternal perceptions of partner responsiveness mediated these associations. We hypothesized that higher mother and father attachment anxiety would be independently and directly associated with higher maternal allostatic load. Although attachment anxiety was not directly associated with maternal allostatic load after covariate adjustment, we found that mother and father attachment anxiety were indirectly associated via mothers' perceptions of partner responsiveness (although a relatively small effect size was detected). Perceptions of partner responsiveness is emerging as a powerful and consistent predictor of health (e.g., Stanton et al., 2019), and attachment anxiety plays a critical role in shaping these perceptions. These findings empirically demonstrate that attachment anxiety is related to health through perceptions of partner responsiveness contributing to our understanding of how relationship factors are related to health and well-being.

Furthermore, these findings highlight the need to consider both partners' attachment anxiety in relation to maternal health. Not only are mothers high in attachment anxiety at risk for poor health but also mothers whose partners (i.e., baby's fathers) are high in attachment anxiety. Prior studies have reported associations between higher partner attachment anxiety and less effective support provision (Collins & Feeney, 2000;

Collins, Ford, Guichard, & Allard, 2006), which suggest that fathers higher in attachment anxiety here may also be less effective support providers and caregivers, with the consequence that mothers perceive lower partner responsiveness. Additional research is needed to evaluate these hypotheses. Regardless, although attention has largely focused on characteristics of mothers in prediction of birth, infant, and maternal outcomes in the past, these findings support an increasing focus on fathers (e.g., Lu et al., 2010; Saxbe, 2017). Furthermore, these findings contribute to the small but growing literature demonstrating partner effects of attachment anxiety on health and begin to answer the call for more systematic investigations of dyadic contributors to health in couples (e.g., Stanton & Campbell, 2014; Pietromonaco, DeBuse, & Powers, 2013).

A novel feature of the study is the measurement of allostatic load in mothers as an index of maternal health. Although it has sometimes been considered a crude indicator of disease risk (see, e.g., Gallo, Fortmann, & Mattei, 2014), allostatic load indices have the advantage of being multisystem risk indicators that capture cardiovascular, metabolic, endocrine, and inflammatory risks. Moreover, allostatic load has predicted many health outcomes, chiefly morbidity and mortality in older populations (Seeman, McEwen, Rowe, & Singer, 2001; Zalli et al., 2014). We note that the effect sizes for indirect effects of mother and father attachment anxiety on maternal allostatic load were relatively small. However, these effects remained after adjusting for covariates. Also, these findings are likely clinically relevant because the maternal allostatic load index was created using predominately clinical cutoffs, rather than statistical criteria. Taken together, the present results suggest that both partners' attachment anxiety may have subtle effects on a clinically relevant index of maternal health through perceptions of maternal perceptions of partner responsiveness.

Another significant strength of the study is the ethnically/racially diverse and predominately low-income sample. The challenges during the year following birth are likely to be exacerbated for low income and/or Black or Latina parents due to the increased likelihood of experiencing more external stressors (e.g., fewer financial resources), more social disadvantages (e.g., fewer positive family relationships and fewer sources of social support), and lower romantic relationship quality compared to more affluent, White couples (Jackson et al., 2014, 2016). As such, perceptions of partner responsiveness in this sample may be particularly important for health. As noted above, the women included in these analyses were older, had higher household income, and were less likely to be Black or married/cohabiting. Although we speculate that these processes would be similarly, if not more, impactful for women not included in analyses, it is possible that this pattern of results does not generalize to all mothers in the CCHN study or all women. These findings need to be replicated in other samples.

The CCHN cohort is the product of a multisite, longitudinal, community-based, participatory research collaboration that involved multiple central research questions and a design involving visits to the homes of low-income, ethnically/racially diverse individuals to do interviews and collect biomarkers. Accordingly, measures were designed through community partnership to reduce participant burden, increase retention, and be culturally sensitive to residents of the participating communities. Individual differences in attachment were not part of the primary research questions of the study. Thus, it was not possible to use the full measures of attachment anxiety or perceived partner responsiveness, nor was it possible to examine attachment avoidance despite known links to biological indicators of health (e.g., Gouin et al., 2009; Maunder, Lancee, Nolan, Hunter, & Tannenbaum, 2006). Similarly, it would have been ideal to assess fathers' perceptions of responsiveness and allostatic load. Because paternal allostatic load was not measured, it is not possible to determine whether these associations were specific to women, or to adjust for the potential covariance between mothers' and fathers' allostatic load. Nonetheless, this is one of the few studies of allostatic load in young adults or mothers. Finally, another limitation resulting from minimizing participant burden was that cortisol slope is based on two saliva samples (wake and bedtime) collected on 1 day, rather than the recommended three to six samples per day for a minimum of 2 days. However, this protocol has been used in other published studies (Adam & Kumari, 2009) and is moderately associated with values obtained from more intensive protocols (Hoyt, Ehrlich, Cham, & Adam, 2016). Thus, these results call for additional research with couples designed for the primary purpose of investigating attachment anxiety and avoidance, perceived partner responsiveness, and health in detail in both mothers and fathers using more complete measures.

We note that in this study, attachment anxiety, maternal perceptions of partner responsiveness, and maternal allostatic load were all measured on one occasion, at 1 year following the birth of a child, which limits the ability to draw causal inferences. It is also possible that additional personality or relationship variables explain these associations. However, attachment anxiety has been linked to relationship outcomes, such as perceptions of support, even after adjusting for other personality constructs (e.g., Collins et al., 2006), and the indirect effects remained significant after adjusting for a number of important covariates. Future research should explore the present associations longitudinally over time to provide stronger causal evidence for the proposed mediational model.

In conclusion, this study examined associations between mothers' and fathers' attachment anxiety and maternal allostatic load as mediated by maternal perceived partner responsiveness in a national sample of low-income and ethnically/racially diverse parents. We found that both mother and father attachment anxiety each indirectly affected maternal allostatic load, such that women who were either higher in attachment anxiety *or* had partners (i.e., baby's father) higher in attachment anxiety viewed their partners as less responsive, and this in turn was associated with higher maternal allostatic load. These findings have implications for relationship processes, especially in understanding the links between mother–father attachment anxiety and maternal health and extend past work to underrepresented couples.

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ORCID iD

Kharah M. Ross https://orcid.org/0000-0002-1472-5630

Open research statement

As part of IARR's encouragement of open research practices, the authors have provided the following information: This research was not pre-registered. The data and material used in the research are available on request by emailing kharah.ross@ucalgary.ca.

Supplemental material

Supplemental material for this article is available online.

Notes

1. Results hold even when cortisol is excluded from the allostatic load index.
2. Most (96%) of participants had nine or more biomarkers available (57% with all 10, 39% with only 9), and only 1% had only 7 biomarkers.
3. The same pattern of results comes through when only cohabiting or married women were included in models.
4. Models were tested with and without direct paths from mother and father attachment anxiety to maternal allostatic load. The two models were not significantly different with respect to model fit, $\Delta\chi^2(2) = 1.70$, $p = .427$. Thus consistent with Pietromonaco et al. (2013), the more parsimonious model, excluding direct paths between mother and father attachment anxiety and allostatic load, is presented.

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