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Associations of social support and stress with postpartum maternal mental health symptoms: Main effects, moderation, and mediation

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ABSTRACT

Poor maternal mental health during the postpartum period can have significant effects on the health of mothers, infants, and families. The findings from cross-sectional studies suggest that stress and social support are related to maternal mental health. This study contributes to the literature through the use of longitudinal data, and examines moderation and mediation among these factors. In 2012–2013, mothers completed surveys assessing stress, social support, and depressive and anxiety symptoms following birth ($n = 125$), and 3 months ($n = 110$) and 6 months ($n = 99$) after birth. The authors examined temporal associations, moderation, and mediation of social support on the relationship between stress and postpartum depressive and anxiety symptoms using modified Poisson regression models and the counterfactual approach to mediation. Current levels of stress and social support were associated with depressive and anxiety symptoms, both independently and when considered together at multiple time points. Social support did not strongly moderate or mediate the relationships between stress and maternal mental health. Interventions to reduce current perceptions of stress and increase social support for mothers during the postpartum period may help improve maternal mental health symptoms. Efforts are needed to assess the current needs of mothers continuously.

Introduction

During the postpartum period, many mothers oscillate between times of happiness and satisfaction and times of challenge, due to the physical and emotional stressors of labor and delivery, and adjustment to a new maternal role (Britton 2008). The Centers for Disease Control and Prevention (CDC) estimated that about 10%–15% of women experience postpartum depressive symptoms, including feelings of hopelessness, lack of interest, or dysphoria, with onset during the first year after delivery (CDC 2008). Postpartum

anxiety symptoms, including increased autonomic arousal (racing heart, dry mouth, or perspiration) and subjective experiences of anxious feelings, also often occur among new mothers, with an estimated 18% of women experiencing anxiety symptoms during the first 3 months postpartum (Farr et al. 2014). Depressive and anxiety symptoms during the postpartum period may have substantial short- and long-term implications for maternal health, above and beyond the clinical symptoms of the mental health condition (Farr et al. 2014; Meltzer-Brody and Stuebe 2014), including physical health symptoms (Farr et al. 2014; O'Hara and McCabe 2013).

Depressive and anxiety symptoms during the postpartum period also have significant implications for the health and development of children and the well-being of families, in part due to the negative influence of the symptoms on maternal parenting behaviors (O'Hara and McCabe 2013). In addition, partners of mothers who experience postpartum depressive or anxiety symptoms are at an increased risk for depression, anxiety, and frequently report feelings of stress, frustration, and hopelessness (Davey, Dziurawiec, and O'Brien-Malone 2006; Tsang et al. 2003). In light of the negative effects for mothers and their families, understanding modifiable factors that may reduce maternal depressive and anxiety symptoms is a public health priority.

Contributing factors to postpartum mental health

Stress

Exposure to stressors and stress often increase during the postpartum period due to infant care demands and changing social role expectations (Razurel et al. 2011). Exposure to stressful events (stressors) and the individual responses to these challenging situations (stress), may contribute to poor maternal mental health during the postpartum period (Manuel et al. 2012; Thomason et al. 2014). The relationship between stress and mental health may be especially pertinent during the postpartum period as 30% of mothers report experiencing psychological and physiological distress due to their postpartum stress (Rallis et al. 2014).

Stressors are often considered as risk factors for postpartum depression or depressive symptoms, however, a recent review found mixed evidence (Yim et al. 2015). Individual stress responses to stressors vary for many reasons Hankin et al. 2015); therefore, mothers' levels of perceived stress may be a better predictor of postpartum depressive symptoms (Yim et al. 2015). Prior studies have shown that perceived stress during the prenatal and postpartum periods is associated with high levels of postpartum depressive or anxiety symptoms (Britton 2008; Thomason et al. 2014). For example, mothers experiencing specific types of stress, such as low perceived competence as a parent, had elevated risk for postpartum depressive or anxiety symptoms (Thomason et al. 2014).

Social support

Perceived social support is defined as the belief that members of one's social network will provide resources, such as emotional, informational, and tangible support, when needed (Cohen 1992). Perceived social support is strongly associated with enhanced life satisfaction and improved affect across the life span (Siedlecki et al. 2014). New mothers have reported an increased need for social support during the postpartum period to adjust to the demands of motherhood, such as physical strain, caring for the infant, and balancing work and child-care demands (Negron et al. 2013). Although interpersonal interactions within the social network may act as a stressor if too much or too little support is received, social support may be key to maternal mental well-being and recovery during the postpartum period (Negron et al. 2013). For women in the postpartum period, perceptions of sufficient social support from their partners have been associated with decreased maternal and infant distress (Stapleton et al. 2012). Low levels of social support, especially from the mothers' parents and romantic partners, and high levels of dissatisfaction with the quality of social support during the postpartum period have been associated with an increased risk of postpartum depressive symptoms (Hildingsson, Tingvall, and Rubertsson 2008; Howell, Mora, and Leventhal 2006). However, it is less clear if low levels of social support directly contribute to an increased risk of depressive or anxiety symptoms or if the effects are a combination of multiple processes. One study found increased levels of social support directly reduced depressive symptoms and also increased mothers' perceived competence, which further reduced depressive symptoms (Ponomartchouk and Bouchard 2015).

Social support as a mediator or moderator of stress

It is clear perceived stress and social support are independently strongly associated with postpartum depressive or anxiety symptoms (Jesse, Kim, and Herndon 2014; Manuel et al. 2012). However, very few studies have examined the effects of social support on the relationship of stress and postpartum depressive or anxiety symptoms (Razurel et al. 2013). Previous studies also have limited investigation to specific stressful events, such as family conflict and natural disasters (Lau, Wong, and Fu 2008; Manuel et al. 2012), rather than overall maternal perceptions of stress. The dearth of evidence regarding social support as a moderator or mediator of the relationship between stress and maternal mental health is a significant impediment to intervention development for mothers and their families (Razurel et al. 2013). Understanding if social support is a moderator, a mediator, or both can guide the development of such interventions. Determining if social support is a moderator of the association between stress and postpartum depressive or anxiety symptoms would help clarify which women tend to be negatively affected by stress and assist in tailoring and targeting the intervention to those who are most likely to respond

to specific intervention efforts (Chmura Kraemer et al. 2008). In contrast, determining if social support is a mediator between stress and maternal post-partum depressive or anxiety symptoms would help clarify whether stress affects these mental health outcomes and assist in determining what components to include in an intervention (Chmura Kraemer et al. 2008).

Given the significant relationships between poor maternal postpartum mental health and the negative health consequences for mothers, children, and families, it is important to understand potentially modifiable factors that may moderate or mediate the association between stress and maternal depressive or anxiety symptoms so that interventions can be developed to improve maternal mental health outcomes. The purpose of this research was to explore the relation of perceived stress and social support to postpartum depressive and anxiety symptoms and to examine the relation of social support to the association between stress and maternal postpartum depressive and anxiety symptoms.

Methods

Conceptual framework

The stress-buffering hypothesis proposed by Cohen and Wills (1985) has been used extensively to examine whether social support is associated with reductions in the potentially adverse effects of stressful events (Biaggi et al. 2016). Cohen and Wills (1985) posited that social support directly contributed to well-being through enhancing positive affect and perceived self-worth (main effect). However, social support may also indirectly improve well-being by mitigating potentially stressful situations or by attenuating the impacts of stressful situations (buffering effect) (Cohen and Wills 1985).

In our application of the stress-buffering hypothesis for postpartum depressive and anxiety symptoms, we expected that mothers with high levels of perceived stress would have an increased risk of above normal depressive or anxiety symptoms. Conversely, we expected that mothers with high perceived social support would have reduced risk of above normal depressive or anxiety symptoms. We also hypothesized that high levels of social support would mediate and moderate the effects of high levels of stress on depressive or anxiety symptoms.

Study population

After receiving approval from the local Institutional Review Board, women were recruited from a large hospital in Iowa within 48 hours of having a live birth. To be eligible for the study, women had to be at least 18 years old and able to speak and read English. Women with multiple births and/or birth complications were not excluded from participation.

Research assistants visited the mother/baby unit three times per week between October and December 2012. They approached mothers who met the eligibility criteria (live birth in past 48 hours, age 18 years or greater, English proficiency), explained the study, and asked if they were interested in participating. Door markers were used to identify mothers who were not currently available (sleeping, provider visiting, etc.) to meet with researchers. Each recruiting session ended when all eligible, available mothers were invited to participate.

Following the provision of written and signed informed consent, all participants completed the first survey using self-administered paper-and-pencil or online methods (Harris et al. 2009). A tablet computer was available to participants who wished to complete the survey online. Participants completed follow-up surveys 3 and 6 months after birth via the method chosen at enrollment. Participants were contacted to complete a follow-up survey only if they had completed a survey at the preceding time point. Given that nurses initially identified potentially eligible individuals, it is unclear how many women were eligible for this study during the enrollment period. Although the protocol was to record the number of women approached during each recruiting session and the number of women enrolled, research assistants did not consistently record this information. Based on the available reports, 70% of women who were invited enrolled in the study. A total of 125 mothers enrolled in the study and completed the first survey. Approximately 10% were lost to follow-up at each subsequent survey (3 months: 15 lost to follow-up, $n = 110$; 6 months: 11 lost to follow-up, $n = 99$). Based on the power calculations for the primary research question for this study, we aimed to recruit 104 mothers, which, after accounting for loss to follow-up, had 80% power to detect modest beta estimates of at least 0.30 with a two-sided alpha equal to 0.05.

Measures

Depressive and anxiety symptoms

Mothers reported their depressive and anxiety symptoms using the short form Depression, Anxiety, and Stress Scales (DASS-21) (Lovibond and Lovibond 1995). In the first survey following birth, participants reported their experiences during pregnancy. In the 3- and 6-month follow-up surveys, participants reported their experiences in the past 3 months.

The depressive and anxiety subscales of the DASS-21 included seven questions focused on each type of negative emotional symptom. Participants reported the frequency of experiencing each symptom on a scale from 0 (*never*) to 3 (*almost always*), with summed scores across the seven subscale items ranging from 0 to 21. In the current sample, Cronbach's alpha for the three time points ranged from 0.76–0.88

for depressive symptoms and 0.52–0.64 for anxiety symptoms. Scores were not normally distributed; thus, for the purposes of this study, each depressive and anxiety symptom score was dichotomized as a normal experience of negative emotions or as a higher than normal experience of negative emotions using the cut-off scores (5 for depressive symptoms, 4 for anxiety symptoms) suggested by the scale developers (Lovibond and Lovibond 1995).

The DASS-21 has been successfully used to assess increased negative emotional symptoms among postpartum women (Cunningham et al. 2013). In prior validation studies, the depressive and anxiety symptom subscales were highly correlated with the Beck Depression Inventory and the Beck Anxiety Inventory (Lovibond and Lovibond 1995).

Stress

Maternal perception of stress, or the extent to which a participant felt mental or emotional strain, irritability, or a tendency to respond disproportionately to stressful situations (Antony et al. 1998) was assessed during the initial survey and at 3 and 6 months postpartum using the stress subscale of the DASS-21 (Lovibond and Lovibond 1995). Participants reported their experiences of seven situations, such as feeling touchy, intolerant of distractions, and agitated on a scale from 0 (*never*) to 3 (*almost always*), with summed scores across the seven items ranging from 0 to 21. In this sample, Cronbach's alpha scores for the stress subscale ranged from 0.81 to 0.84 at the three time points. Stress was modeled as a continuous variable, with higher scores indicating a greater experience of stress. The DASS-21 has been successfully used to assess increased negative stress symptoms with postpartum women (Cunningham et al. 2013). Prior research indicated that the three subscales of the DASS measured three distinct categories of negative emotional symptoms (Sinclair et al. 2012) and should be considered separately to understand the nature of psychological well-being (Shea, Tennant, and Pallant 2009). Multiple authors have hypothesized a relationship of high stress levels and heightened depressive and anxiety symptoms during the postpartum period, which may explain the correlation between the subscales (Britton 2008; Groer and Morgan 2007; Thomason et al. 2014).

Social support

The RAND Medical Outcomes Study Social Support Survey (MOS-SSS) is a 19-item scale that measures different types of support. Participants rated their perceptions of support availability on a scale from 1 (*none of the time*) to 5 (*all of the time*). This study included the emotional/informational support, affectionate support, and positive social interaction subscales. Social support was modeled as the average score across the 19 items. The

Cronbach's alpha scores suggested a high degree of internal consistency on the overall scale at each of the three time points (range: 0.97–0.98). The MOS-SSS has been successfully used with a wide range of populations, including postpartum women (Da Costa et al. 2010).

Statistical analysis

Univariate analyses were used to describe the demographic composition and psychological well-being of the sample. Bivariate analyses of depressive and anxiety symptoms by time were used to graph the changes in maternal psychological well-being during the first 6 months of the postpartum period to examine the heterogeneity of experiences across time.

Next, modified Poisson regression models proposed by Zou (2004) were used to calculate the crude relative risk for experiencing depressive or anxiety symptoms at 3 or 6 months postpartum for a one-unit increase in the average score on the MOS-SSS (social support) and total stress score in each of the previous time points. These analyses were followed by a series of multivariable modified Poisson regression models (Zou 2004) to examine further the key relationship. To control for the association of prior social support with current social support, the relative risks were adjusted for social support in all prior time points (e.g., the relative risk for depressive symptoms at 6 months after delivery was adjusted for social support reported at birth and 3 months). Similar relative risk estimates were calculated for stress, adjusted for perceived stress at prior time points. Adjusting for the score at prior time points also clarified the temporal relationship between support or stress and maternal mental health. The next model was adjusted for both social support and stress during the same time period and maternal age, education, and mental health symptoms reported after delivery.

Moderation, the extent to which the relationship between stress and maternal mental health was altered by social support, was assessed by adding an interaction between stress and social support to the models. Moderation models were calculated with stress and social support as continuous variables, which were consistent with earlier results, and also with stress as a continuous variable and social support as a dichotomous variable split at the mean score. The direction and significance of the results of the two models were the same, and the Akaike Information Criterion (Akaike 1974) of the two models were also similar; thus, we present the simplified analysis with social support as a dichotomous variable.

Mediation, the extent to which social support is part of the causal pathway between stress and maternal mental health, was assessed using the counterfactual approach to mediation through the SAS macro developed by Valeri and VenderWeele (2013). The counterfactual approach extends the product method approach to mediation developed by Baron and Kenny (1986) to

allow for the calculation of total effects as the sum of the direct and indirect effects in the presence of nonlinearities (Valeri and VanderWeele 2013). The log-linear mediation models failed to converge; thus, we used logistic regression for modeling these relationships and reported the odds ratios (OR) and 95% confidence intervals (CI) produced by these models.

Based on the literature review and a directed acyclic graph (DAG), a visual method of selecting potential confounders to avoid introduction of conditional bias (Shrier and Platt 2008), we included prenatal depressive or anxiety symptoms, education, and age as covariates. All analyses were conducted using SAS version 9.4.

Results

On average, mothers were 30 years old (mean = 29.7 years; *SD* = 5.6 years), and the majority (62%) had multiple children (Table 1). As was consistent with the demographic characteristics of the surrounding community, the majority of mothers were white (76%), non-Hispanic (94%), and had earned some college credit (86%). The proportion of mothers who experienced only above-normal depressive symptoms (i.e., normal anxiety levels, heightened depressive symptoms) increased over time (Figure 1). In contrast, the proportion of mothers who experienced only above-normal anxiety symptoms (i.e., normal depressive symptoms, heightened anxiety symptoms) decreased over time. Approximately 5% of mothers reported above-normal symptoms of depressive and anxiety at each of the data collection points. The scores for perceptions of social support ranged from 1 to 5, with 5 indicating higher

Table 1. Demographic characteristics of the sample (*n* = 125).

Demographic characteristics	Mean (*SD*) or number[a] (%)
Age (in years)	29.7 (*SD* = 5.6)
Race	
Non-White	30 (24.00)
White	95 (76.00)
Ethnicity	
Hispanic	7 (5.60)
Non-Hispanic	118 (94.40)
Relationship status after delivery	
Single	9 (7.44)
In a relationship	112 (92.56)
Parity	
First child	47 (37.90)
Multiple children	77 (62.10)
Education	
High school diploma or less	17 (13.60)
At least some college credit	108 (86.40)
Initiated breastfeeding	
Yes	97 (88.18)
No	13 (11.82)

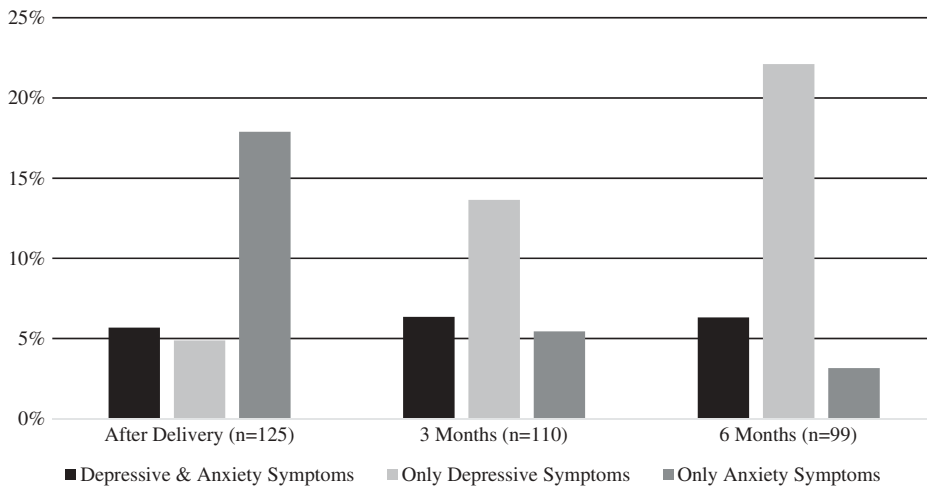[a]Range from 110 to 125 due to missing data.

Figure 1. Proportion of mothers reporting above normal depressive and anxiety symptoms.

perception of social support. The mean social support scores after delivery (mean = 4.57, SD = 0.63), at 3 months postpartum (mean = 4.27, SD = 0.81), and at 6 months postpartum (mean = 4.40, SD = 0.78) were high (Table 2). Stress scores ranged from 0 to 21, with a higher score indicating higher perceptions of stress. The mean stress scores ranged from 4.59 to 4.86 across the three time points, indicating modest levels of stress over the three time periods.

In unadjusted analyses, higher levels of social support reported after delivery and at 3 months postpartum were associated with a decreased risk of experiencing above-normal depressive symptoms at 3 months postpartum (Table 3). For above-normal depressive symptoms at 6 months postpartum, only higher social support reported after delivery was associated with reduced risk. Social support was not strongly associated with anxiety symptoms at 3 or 6 months postpartum; however, higher social support reported at 3 months postpartum was significantly associated with reduced risk of above-normal 3-month anxiety symptoms.

Overall, in unadjusted analyses, higher perceived levels of stress were associated with an increased risk of above normal depressive and anxiety symptoms (Table 3). However, 3-month stress scores were not significantly associated with above-normal anxiety symptoms at 3 months postpartum. In contrast to the social support relationship, stress at prior time points was significantly associated with future reports of depressive and anxiety symptoms.

Adjusting for prior reports of social support at 3 months postpartum, higher current perceptions of social support were associated with significantly reduced risk of above-normal depressive and anxiety symptoms (Table 3). Social support was not significantly associated with 6-month

Table 2. Exposure, mediator/moderator, and outcome characterstics.

Mental health symptoms[a]	Mean (SD)
Scores after delivery	
Depressive symptom subscale	2.05 (2.08)
Anxiety symptom subscale	2.12 (2.06)
3-month scores	
Depressive symptom subscale	2.46 (2.29)
Anxiety symptom subscale	1.45 (1.62)
6-month scores	
Depressive symptom subscale	2.89 (3.07)
Anxiety symptom subscale	1.38 (1.76)
Social support experiences[b]	
After delivery social support	4.57 (0.63)
3-month social support	4.27 (0.81)
6-month social support	4.40 (0.78)
Stress experiences[c]	
Scores after delivery	4.85 (2.95)
3-month scores	4.59 (2.89)
6-month scores	4.86 (3.23)

[a]Possible scores range from 0 to 21.
[b]Possible scores range from 1 to 5.
[c]Possible scores range from 0 to 21.

depressive or anxiety symptoms after controlling for past reported social support. At 3 months postpartum, higher current stress was associated with above-normal depressive symptoms but was not associated with above-normal anxiety symptoms, controlling for current and past reported stress. High stress reported at each time point was significantly associated with 6-month above-normal depressive symptoms. Contrary to the rest of the findings, increased stress reported after delivery was associated with lower risk of above-normal depressive symptoms after controlling for stress reported at each time point. Increased stress at 3 and 6 months postpartum was associated with significantly increased risk of above-normal depressive symptoms at 6 months postpartum. Increased stress at 6 months postpartum was associated with increased risk of above-normal anxiety symptoms at 6 months postpartum.

Adjusting for stress and social support reported during the same time period and for the covariates of maternal age, maternal education, and maternal reported depressive or anxiety symptoms after delivery, at 3 months postpartum, higher perceptions of stress and lower perceptions of social support were significantly associated with above-normal postpartum depressive symptoms (Table 3, Model 1). At 6 months postpartum, only increased stress was significantly associated with above-normal depressive symptoms. At 3 months postpartum, only increased social support was associated with reduced risk of above-normal anxiety symptoms. Neither stress nor social support was significantly associated with 6-month postpartum anxiety symptoms.

Table 3. Temporal relative risks (RR) and 95% confidence intervals (CI) for stress and social support in relation to maternal depressive or anxiety symptoms.

	Depressive symptoms RR (95% CI)		Anxiety symptoms RR (95% CI)	
	3 months after delivery	6 months after delivery	3 months after delivery	6 months after delivery
Unadjusted relative risk				
Social support[a]				
After delivery	0.62 (0.49–0.80)	0.73 (0.87–0.92)	0.85 (0.47–1.54)	0.87 (0.36–2.12)
3 months	0.56 (0.44–0.71)	0.81 (0.61–1.07)	0.61 (0.41–0.89)	0.67 (0.35–1.27)
6 months	—	0.77 (0.56—1.04)	—	0.62 (0.36–1.07)
Stress[b]				
After delivery	1.22 (1.10–1.34)	1.15 (1.04–1.26)	1.20 (1.05–1.37)	1.26 (1.05–1.51)
3 months	1.38 (1.27–1.50)	1.19 (1.09–1.30)	1.20 (0.99–1.47)	1.21 (1.04–1.41)
6 months	—	1.19 (1.10–1.28)	—	1.22 (1.15–1.29)
Relative risk adjusted for prior experiences[c]				
Social support[a]				
After delivery	1.02 (0.72–1.45)	0.88 (0.61–1.27)	1.36 (0.69–2.69)	1.24 (0.42–3.72)
3 months	0.52 (0.38–0.71)	0.97 (0.61–1.53)	0.52 (0.33–0.82)	0.71 (0.26–2.00)
6 months	—	0.79 (0.48–1.31)	—	0.77 (0.34–1.75)
Stress[b]				
After delivery	1.07 (0.72–1.25)	0.84 (0.74–0.96)	1.13 (0.94–1.36)	0.78 (0.57–1.05)
3 months	1.35 (1.21–1.50)	1.15 (1.06–1.25)	1.13 (0.87–1.47)	1.21 (1.00–1.44)
6 months	—	1.27 (1.17–1.39)	—	1.39 (1.16–1.67)
Model 1[d]				
Social support[a]	0.53 (0.40–0.72)	0.86 (0.65–1.15)	0.65 (0.40–1.00)	0.59 (0.31–1.11)
Stress[b]	1.39 (1.26–1.54)	1.16 (1.06–1.26)	1.19 (0.96–1.49)	1.08 (0.96–1.22)

[a]One point increase in average social support score.
[b]One point increase in stress score.
[c]Social support variables adjusted for prior time period(s) social support, stress variables adjusted for prior time period(s) stress.
[d]Adjusted for maternal age, maternal education, maternal after delivery mental health symptoms, and stress and social support during the same time period.

Moderation analysis

Overall, evidence to support moderation of the relationship between stress and depressive or anxiety symptoms by social support was limited after controlling for maternal age, education, and depressive or anxiety symptoms reported at birth (Table 4), except for depressive symptoms at 6 months ($p < .01$). The adjusted relative risk (aRR) of experiencing depressive symptoms at 6 months was significantly lower (aRR: 0.29; 95% CI: 0.10–0.78) among mothers with high social support in the first quartile of stress score, compared with mothers with low social support in the first quartile of the stress scores. In contrast, social support was not significantly protective against depressive symptoms among mothers in the third quartile of stress scores (aRR:0.73; 95% CI: 0.40–1.33). For 3-month depressive and anxiety symptoms and 6-month anxiety symptoms, the relations of stress to symptoms did not significantly differ by level of social support.

Table 4. Moderation of the relative risks (RR) (with 95% confidence intervals [CI]) of stress in relation to depressive or anxiety symptoms by social support.[a]

	High social support RR (95% CI)	Low social supportm RR (95% CI)	RR (95% CI) by social support within strata of stress
3-Month depressive symptoms[b]			
3rd quartile stress score	0.83 (0.35–1.96)	1.62 (1.33–1.97)	0.52 (0.22–1.19)
Median stress score	0.34 (0.11–1.09)	Ref	0.34 (0.11–1.09)
1st quartile stress score	0.14 (0.03–0.68)	0.62 (0.51–0.76)	0.23 (0.05–1.11)
6-Month depressive symptoms[c]			
3rd quartile stress score	0.92 (0.49–1.71)	1.26 (1.07–1.48)	0.73 (0.40–1.33)
Median stress score	0.46 (0.22–0.97)	Ref	0.46 (0.22–0.97)
1st quartile stress score	0.23 (0.09–0.59)	0.80 (0.67–0.94)	0.29 (0.10–0.78)
3-Month anxiety symptoms[b]			
3rd quartile stress score	0.46 (0.09–2.33)	1.59 (103–2.44)	0.29 (0.06–1.39)
Median stress score	0.35 (0.9–41.29)	Ref	0.35 (0.10–1.29)
1st quartile stress score	0.26 (0.06–1.18)	0.63 (0.41–0.97)	0.41 (0.07–2.34)
6-Month anxiety symptoms[b]			
3rd quartile stress score	0.40 (0.06–2.69)	1.49 (1.26–1.76)	0.27 (0.04–1.82)
Median stress score	0.20 (0.02–2.26)	Ref	0.20 (0.02–2.26)
1st quartile stress score	0.10 (0.01–1.93)	0.67 (0.57–0.79)	0.15 (0.01–2.84)

[a]Adjusted for maternal age, depressive or anxiety symptoms at birth, and maternal education.
[b]Interaction term not significant at $p < .05$.
[c]Interaction term significant at $p < .01$.

Mediation analysis

For the mediation models (Table 5), the direct effect, which was significant across depressive or anxiety symptoms, was interpreted as the odds of above normal depressive or anxiety symptoms for a change from the 25th percentile to the 75th percentile of the stress scale scores, assuming social support was constant and controlling for maternal age, maternal education, and depressive or anxiety symptoms report following birth. The direct effect measured the relation of stress to depressive or anxiety symptoms if we disabled the pathway from stress to social support. The indirect effect, the association of stress with depressive or anxiety symptoms by changing social support, was also significant for 3-month depressive symptoms, and 3- and 6-month anxiety symptoms. Finally, the total association, which was also significant across depressive and anxiety symptoms, was the overall change in depressive or anxiety symptoms based on changing stress score from the 25th percentile to the 75th percentile. Overall, the direct relations of stress to depressive and anxiety symptoms explained a much higher proportion of the total than the indirect effects, which suggested that mediation by social support was minimal.

Discussion

The purpose of this research was to explore the relations of perceived stress and social support to postpartum depressive and anxiety symptoms and to

Table 5. Mediation of odds ratios (OR) with 95% confidence intervals (CI) for the association of stress with depressive or anxiety symptoms by social support.[a]

	Depressive symptoms		Anxiety symptoms	
	OR (95% CI)		OR (95% CI)	
	3 months after delivery	6 months after delivery	3 months after delivery	6 months after delivery
Mediation				
Direct effect	5.85 (2.67–12.83)	147.63 (73.57–296.21)	1.84 (1.45–2.34)	22.92 (9.49–55.37)
Indirect effect	1.11 (1.03–1.21)	1.00 (0.95–1.05)	1.04 (1.01–1.06)	1.12 (1.04–1.21)
Total effect	6.51 (2.95–14.37)	147.93 (73.7–296.89)	1.91 (1.50–2.43)	25.67 (10.41–63.33)

[a]Adjusted for maternal age, depressive or anxiety symptoms at birth, and maternal education.

examine the associations of social support with the relationship between stress and maternal postpartum depressive and anxiety symptoms. Although much research has supported the relationship of stress and social support to maternal mental health, limited research has examined the temporal relationships and the combined effects of stress and social support on maternal mental health.

Stress

In this study, increased levels of stress were associated with increased risk of above-normal depressive and anxiety symptoms during the postpartum period. Overall, the current stress level measured at the same time was significantly associated with anxiety and depressive symptoms, adjusting for prior stress. This finding was consistent with prior research showing that maternal stress was associated with increased depressive symptoms related to the novel stressors related to caring for an infant (Mott et al. 2011) and may suggest that stress has an important relation to depressive and anxiety symptoms. Thus, ongoing stress reduction interventions during the postpartum period may be an effective way to improve maternal mental health. Because our data showed that the associations of stress with depressive and anxiety symptoms may change over time, it may be necessary to tailor the intervention to maternal stress throughout the postpartum period.

Social support

In this sample of mothers, positive social support was associated with reduced risk of depressive and anxiety symptoms at 3 months postpartum. These associations persisted after adjusting for social support, perceived stress, and depressive or anxiety symptoms at earlier time points, maternal age, and maternal education. Prior cross-sectional research suggested social

support improves maternal mental health outcomes during the postpartum period (Boury, Larken, and Krummel 2004; Howell, Mora, and Leventhal 2006), which was consistent with our findings. Our results showed that current perceptions of social support were associated with depressive and anxiety symptoms at 3 months postpartum, but social support was not protective against depressive or anxiety symptoms at 6 months postpartum. The significant relationships between current perceptions of social support and maternal mental health in the early postpartum period highlight the relative importance of current social support needs compared with previous support received, which may suggest maternal experience of and need for social support changes over time (Asselmann et al. 2016). Given the importance of social support in our findings and the prior literature, interventions using social support to reduce depressive and anxiety symptoms during the postpartum period may be most effective if they are provided at multiple points during the period and are flexible to meet the specific needs of the mothers across time. Additional research may further clarify the characteristics of social support desired by mothers across the postpartum period, such as what type of social support is needed, who best provides the support, and when support is most helpful (House 1981).

Moderation and mediation of stress and social support

Our findings do not support social support as a moderator or mediator of the relationship between stress and depressive and anxiety symptoms. Both stress and social support were associated with maternal mental health during the early postpartum period; thus, it may be necessary to address both issues in interventions among new mothers. At 6 months postpartum, social support did significantly moderate the association between stress and depressive symptoms, which may suggest social support should continue to be the focus on interventions to reduce depressive symptoms. Social support may be addressed through interventions, such as the Mothers' Advocates in the Community, a promising intervention that pairs a new mother with a non-professional mentor during the postpartum period (Taft et al. 2011). Mindfulness-based interventions also show promise in improving mental health during the postpartum period through reducing the effects of stressors (Vieten and Astin 2008). Despite the independent pathways of effect of social support and stress on maternal mental health, it may be possible to tailor an intervention to mothers to address both perceptions of social support and stress. For example, a novel intervention could combine the mentoring from Mothers' Advocates in the Community with teaching mindfulness-based interventions.

Limitations

This study sample was relatively homogeneous (i.e., predominately white race with above average education), reflecting the community in which this study was conducted, but potentially reducing the generalizability of results. While mothers were followed for 6 months after birth of the infant, it is possible that the relationships between stress, social support, and postpartum depressive and anxiety symptoms changed during the remainder of the postpartum period that was not included in the study. However, this study captured one of the most stressful periods, immediately after birth, when mothers are adjusting to the care of new infants (Mulsow et al. 2002).

Although previous studies reported good internal consistency of the DASS anxiety subscale in postpartum samples (Cunningham et al. 2013), it was lower than expected in this sample and thus could have resulted in misclassification or inaccuracy of results. The low alpha score may indicate that the anxiety measure captured multiple facets of emotional distress rather than a single indicator of anxiety, or that the DASS-21 is not an appropriate measure of post-partum anxiety. Future research using the DASS-21 may consider including another measure of anxiety to gain additional information. Finally, the study may have been insufficiently powered to detect moderation and mediation effects. Future research with a larger, more diverse sample and longer follow-up period may be necessary to examine these complex relationships further.

Implications

This study is among the first to examine the relationships of social support and stress with maternal depressive and anxiety symptoms across multiple time points during the early postpartum period, examining the potential combined impacts of social support and stress (Razurel et al. 2013). Our findings highlight the importance of interventions during the early postpartum periods to reduce stress and increase social support to improve mothers' mental health. Considering that stressors and support needs change over time, future research should identify the types of stressors and support relevant to each time point, including what type of social support is needed and who should provide the support to have the greatest effect on maternal mental health.

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