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Maternal Anxiety, Sleep, and Parenting in Postpartum African American Mothers

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Maternal Anxiety, Sleep, and Parenting in Postpartum African American Mothers

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Abstract

Maternal Anxiety, Sleep, and Parenting in Postpartum African American Mothers

By Madeleine Flora Cohen

A well-established body of literature suggests that positive maternal parenting behaviors in early infancy are paramount, given their ability to impact later child development. Notably, these parenting behaviors have been shown to be negatively impacted by the presence of both heightened maternal anxiety and poor maternal sleep quality. Each of these maternal-based predictors are of particular concern during the postpartum period, the 12-months that elapse after the birth of an infant. However, to our knowledge, no study has examined the relationships between each of these factors – maternal anxiety, sleep, and parenting behaviors – across the postpartum period. Further, there is a paucity of quantitative work on postpartum sleep quality in African American women, which is of clinical relevance as these women tend to experience relatively poor sleep quality. As such, the current study examined relationships between each of these factors at three study timepoints – 3-, 6-, and 12-months postpartum – in an entirely African American sample. Hierarchical Linear Modeling was used to first explore the trajectories of study variables across the postpartum period. Results indicated that maternal demonstrations of positive parenting behaviors decrease from 3- to 12-months postpartum, whereas other study variables remained stable across these timepoints. Neither maternal anxiety nor maternal sleep quality predicted demonstrations of positive or negative parenting behaviors either cross-sectionally or longitudinally. However, maternal anxiety and maternal sleep showed both cross-sectional and time-lagged associations with one another. Specifically, maternal anxiety symptomatology drove maternal sleep quality across study timepoints. Findings suggest that in this group of African American women, additional factors (e.g., infant negativity, infants' own sleep) may be more predictive of maternal parenting behaviors than maternal anxiety or sleep. Future work is warranted to explore the relevance of maternal anxiety and sleep to parenting later in development. Nonetheless, study findings offer quantitative support for linkages between psychological functioning and sleep in a community sample of postpartum African American women.

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Maladaptive early parenting strategies have been linked to later child behavioral and psychological problems. Therefore, a deepened understanding of the predictors that shape both positive and negative maternal parenting behaviors during infancy may have important theoretical and clinical implications for developmental psychopathology. Maternal psychological functioning has been studied as one such predictor of parenting in infancy; however, focus has largely been on maternal depression rather than anxiety (Matthey et al., 2003; Ross & McLean, 2006). This difference persists despite estimated prevalence rates for maternal postpartum anxiety of 17.1% (Fairbrother et al., 2016). An additional factor that is highly salient to the postpartum period and may also have impacts on parenting is maternal sleep, or lack thereof. Not unlike maternal anxiety, maternal sleep remains relatively understudied as a predictor of parenting behaviors in infancy. Sleep in the postpartum period is typically investigated through the lens of infant sleep, with maternal sleep often viewed as an afterthought or a necessary sacrifice. Recent efforts to consider the interplay between women's sleep and mood disorders (Lawson et al., 2015) aim to do away with this notion and gain a fuller picture of the psychological correlates of sleep. The current study extends this line of work in a longitudinal community sample of postpartum women, examining both maternal anxiety and maternal sleep, how they relate to one another, and their potentially important associations with early parenting quality.

Maternal Postpartum Sleep

According to the National Sleep Foundation, healthy adults require 7 to 9 hours of sleep each night (Hirshkowitz et al., 2015), but women in the postpartum period sleep on the lower end of this range (see Hunter, Rychnovsky, & Yount, 2009 and Nowakowski, Meers, & Heimbach, 2013 for reviews). Women often report lower sleep quality during pregnancy, but postpartum

sleep may be of even worse quality and is often shorter in duration (Matsumoto et. al., 2003). Postpartum mothers' widespread complaints of fatigue and sleep-related disturbances are corroborated by objective sleep measurements (e.g., actigraphy) (Corwin & Arbour, 2007; Giallo et al., 2015). More than half (55%) of postpartum women report that their nighttime sleep is poor. Of this subset of women, 12.3% describe lengthy sleep onset (defined as attempting to fall asleep for a period longer than 30 minutes), and 37.0% of postpartum women describe unplanned nighttime and/or early morning awakenings (Mindell, Sadeh, Kwon, & Goh, 2013). Poor sleep quality is among the most frequent concerns of new mothers, suggesting its importance as a clinically-relevant topic for research and intervention.

The postpartum period is a unique time that may engender physiological, environmental, and psychological effects on sleep. With respect to physiological changes, levels of the hormone progesterone decline during the postpartum period. Because progesterone has sedative-like qualities, its decline may be related to concomitant decreases in maternal postpartum sleep duration and quality (Albrecht & Pepe, 1990; Swain et al., 1997; Lee, Zaffke, & McEnany, 2000; Moline et al., 2003). In addition to hormonal decreases in progesterone, Parry et al. (2008) reported changes in new mothers' melatonin levels at 3-months postpartum. Melatonin is typically measured through blood plasma and its concentration varies over the course of the day, with larger secretions typically occurring prior to sleep onset. In addition to these physiological influences on sleep, there are also salient alterations to the physical environment (i.e., the arrival of a new child). Undeniably, maternal sleep schedules must adjust to infant feeding schedules (Thomas & Foreman, 2005), and more broadly, maternal sleep patterns occur in parallel to infant sleep patterns, with evidence suggesting that infant sleep may be driving this alignment (Dennis & Ross, 2005; Thomas & Foreman, 2005). Coupled with the major daily life changes associated

with caring for a newborn infant (e.g., scheduling feeding times, shifting the existing structure of the family unit, and re-calibrating working hours and a daily routine), sleep– is yet another maternal consideration to be managed. Physiological and environmental effects on sleep likely work in tandem with psychological influences on mothers' sleep. Indeed, an emerging body of research suggests that, for mothers, there also exist personal barriers to sleep quality, beyond the environmental factors directly associated with their newborn infants (Doering, 2013; Zambrano et al., 2016; Creti et al., 2017). Essentially, infant sleep is not the only factor that impacts maternal sleep quality.

For instance, in a study of low socioeconomic status (SES) African American mothers, the majority of women continued to characterize their sleep as "poor" from 3 to 6 months postpartum (Zambrano et al., 2016), despite the fact that infants' sleep lengthens and improves across these time points (Jenni & Carskadon, 2012; Nowakowski, Meers, & Heimbach, 2013). This discrepancy – maternal sleep subjectively remaining poor whilst infant sleep is consolidating – suggests that maternal sleep and infant sleep are not fully analogous to one another. Maternal sleep-related "barriers" may be both physical (i.e., the sleep environment itself, defined by the National Sleep Foundation (2011) as tangible factors that promote or hinder falling asleep) and psychological (i.e., related to symptoms of depression and/or anxiety). The latter set of barriers is consistent with an increased interest in conceptualizing sleep as an important predictor and driver of psychological functioning.

Maternal Anxiety and Sleep in the Postpartum Period

Insufficient sleep patterns have been tied to symptoms of anxiety in the general population (Alvaro, Roberts, & Harris, 2013). While directionality remains unclear (Ross, Murray, & Steiner, 2005), a burgeoning literature suggests that there are also meaningful

relationships between sleep and anxiety in postpartum women. That is to say, mothers who suffer from poor sleep also report symptoms of anxiety, and vice versa (Creti et al., 2017; Okun et al., 2018). For instance, Okun's group (2018) studied a group of mothers at 6-months postpartum, and found that poorer maternal sleep quality (using the global index of sleep as assessed by Buysse et al.'s 1989 Pittsburgh Sleep Quality Index) was associated with increased anxiety symptomatology. Notably, these associations persisted even when controlling for the existence of prenatal depression and anxiety. In contrast, Tham's group (2016) found that self-reported sleep quality was associated with self-reported depression, but not anxiety at 3-months postpartum. Despite conflicting results, it is notable that each of the aforementioned studies probe only cross-sectional relationships between sleep and anxiety. There is a need in this area for longitudinal studies that trace the associations between sleep and anxiety throughout the first year postpartum in order to more closely estimate causal associations.

Maternal Anxiety and Parenting Behaviors in the Postpartum Period

As stated previously, parenting behaviors in the postpartum period are paramount, given their potential to impact upon infant attachment (Arnott & Brown, 2013), language development (Reck et al., 2018) and early childhood socioemotional development (O'Connor et al., 2002). It is thought that mothers who suffer from anxiety (at both clinical and sub-clinical levels) are more likely to overstimulate their infants, and to demonstrate increased intrusive behavior and blunted sensitivity than those who do not (see Kaitz & Maytal, 2005 for a review). Various researchers have put forth explanations for these phenomena including worry-based cognitive disturbances, increased startle responses, and a perceived lack of control.

For example, Stein et al. (2012) followed 90 mothers with Generalized Anxiety Disorder (GAD), diagnosed in the postpartum period at 3- or 6-months, until their infants were 10-months

of age. At this latter time point, mothers and their infants completed two parent-child interactions, one prior to, and one following the delivery of a 5-minute prime narrative. Participants were randomized to receive either a worry/rumination prime or a neutral prime (Stein et al., 2012). Planned analytic comparisons indicated that mothers with GAD who were exposed to the worry/rumination prime showed decreased responsiveness and decreased infant-directed speech during interactions with their infants. The authors concluded that worry-based thoughts in anxiety-prone mothers acted as emotionally-laden cognitive disturbances, reducing their ability to attend and respond well to their infants.

While worry-based cognitive disturbances may be one mechanism by which anxiety is transmitted into parenting *in situ*, it is likely that there are other mechanisms at work as well. Kaitz & Maytal (2005) synthesized observational studies of mother-child interactions in which mothers displayed both clinical and sub-clinical levels of anxiety, and proposed several explanations for intrusive parenting behaviors. First, they suggested that anxiety more broadly may be linked to an increased startle response. When presented with a distressing situation (e.g., a crying or temperamentally difficult infant), the susceptibility to a heightened startle response translates to high arousal in mothers. This high arousal may be behaviorally expressed as over-engaging or intrusively-laden infant-directed behavior. In addition, the authors proposed that the general desire for and perceived lack of control associated with anxiety symptomatology (Chorpita & Barlow, 1998) may result in mothers' tendency to counteract this ego-dystonic feeling. That is, intrusive infant-directed behaviors may be an artifact of mothers over-compensating to regain their control and self-efficacy in their parenting role.

The degree to which mothers display sensitivity is also of concern for mothers experiencing psychological distress (e.g., anxiety). Despite their seemingly orthogonal qualities,

intrusiveness and sensitivity often co-vary in observational measures of parenting. Specifically, mothers who tend to demonstrate higher sensitivity (e.g., positivity, warmth, responsiveness, etc.) typically demonstrate fewer intrusive behaviors (e.g., overstimulation coupled with negativity, a lack of responsiveness, etc.). Importantly, both *low* sensitivity and *high* intrusiveness are most salient when parenting-related distress is present (Lyons-Ruth & Spielman, 2004). We argue that such distress might stem from heightened maternal anxiety. For instance, Seymour's group (2014) found that the presence of heightened maternal anxiety was associated with low parenting warmth, decreased parental involvement, decreased feelings of parental self-efficacy and satisfaction, and increased hostility towards infants 0 to 11 months of age. While these parenting behaviors were self-reported and not observed, parenting stress and parenting beliefs more broadly are thought to drive the expression of parenting behaviors (Teti and Crosby, 2012; Chau & Giallo, 2015). That is, parenting-related cognitions can be predictive proxies of observable parenting behaviors. Similarly, Nicol-Harper and colleagues (2007) observed mother-infant interactions between "high" and "low" anxious mothers and their infants. Mother-infant interactions were conducted in the home, lasted for 10 minutes duration, and included a free play and the presentation of age-appropriate toys. Researchers made use of a rating scale developed by Stein et al. (1994), and found that mothers reporting high trait-anxiety displayed decreased sensitivity, as well as decreased emotional tone (an index of positivity that subsumes facial, vocal, and behavioral aspects of positive affect). As maternal anxiety and depression tend to be highly comorbid, analyses were repeated, controlling for maternal self-reported depressive symptoms. The aforementioned pattern of results held, suggesting that lower levels of sensitivity and positivity observed in "high" anxiety mothers were related to their anxiety symptoms, above and beyond any underlying depressive symptomatology. These results

are in contrast to the work of Feldman et al. (2009), who found that observed maternal sensitivity at 9-months postpartum was lowest among mothers with depressive symptomatology, relative to mothers with anxiety. However, mothers with anxiety still demonstrated decreased sensitivity relative to mothers who did not endorse either depression or anxiety. Overall, despite a relative consensus regarding relationships between maternal anxiety and intrusiveness, there exist mixed patterns of results with regard to maternal anxiety and sensitivity. This difference suggests a need to develop a fuller picture of positive parenting behaviors (in addition to negative parenting behaviors, such as intrusiveness) and their trajectory across the first year postpartum.

Maternal Sleep and Parenting Behaviors in the Postpartum Period

It may be that maternal sleep - similar to anxiety - exerts influences on maternal parenting behaviors. At the extreme, poor parental sleep has been identified as a risk factor for child abuse (Owens, 2005). In a more basic sense, sleep disturbances and ensuing fatigue may sway mother-child interactions, such that when sleep suffers, mothers respond to their infants less optimally than they would following a full night's sleep. Support for this idea in the literature is strong, but hampered by the fact that studies are often conducted in older children and/or using self-report of parenting behaviors (as opposed to observational studies).

For instance, Chau & Giallo (2015) investigated the effects of maternal fatigue on parenting of children 0 to 4 years old. The authors found evidence of a direct effect of parental fatigue on decreased parental warmth and increased hostility, as well as an indirect effect whereby parental self-efficacy fully mediated these relationships. In essence, more debilitating fatigue was associated with decreases in parental self-efficacy, which resulted in decreased positive parenting behaviors and increased negative parenting behaviors. Similarly, Cooklin, Giallo, & Rose (2011) showed that more significant maternal fatigue was associated with

decreased feelings of parental competence, heightened parenting stress, and increased feelings of irritability towards children ages 0 to 5 years old. Interestingly, each of the studies noted thus far utilize the term *fatigue* to investigate these relationships, rather than investigating *sleep quality* more directly as it pertains to parenting. Treharne and colleagues (2008) define *fatigue* as a "systemic feeling of exhaustion." Certainly, this feeling state may arise when sleep quality is lacking, but mention of fatigue assumes that sleep deprivation is being manifested at an extreme. The definition of fatigue also assumes a cogent self-awareness of sleepiness and its effects (e.g., altered parenting behaviors). This is in contrast to the sleep quality information revealed from sleep questionnaires (e.g., decreased sleep efficiency, increased wake after sleep onset, among others) that mothers may not be consciously aware of. While fatigue and sleep disturbances are no doubt related, a clearer understanding of sleep itself (above and beyond the index of fatigue) as it relates to parenting is still needed.

Studies that do investigate maternal sleep (rather than fatigue) and its associations with parenting offer promising evidence of an important relationship. For instance, in a study of typically developing children (ages 3 to 14), Meltzer & Mindell (2007) found that maternal sleep quality accounted for 26% of the variance in self-reported parenting distress. The postpartum period may be an important time to examine similar associations, given the higher level of parental care required for children at this younger (and thus more maternally-dependent) age. Indeed, Sinai & Tikotzky (2012) demonstrated that for mothers of 4- to 5-month-old infants, decreased maternal sleep was related to self-reported parenting stress. In one of few observational studies on this topic, Parker White et al. (2015) found significant relationships between sleep and parenting in an observational study of mothers and their toddlers (ages 2 and 3). Dyads were asked to play together, in sight of a toy that would be enviable to toddlers, and

mothers were encouraged to keep their toddlers from touching said toy. Questionnaires were utilized to assess for the predictors of both fatigue and sleep quality. Results indicated that increased maternal fatigue and decreased sleep were associated with a decreased tendency to praise and act well-mannered towards toddlers. While this study was conducted in a children older than infancy, the results suggest that mother-child interactions provide a meaningful context to investigate the effects of maternal sleep on parenting behaviors. Studies are neededto investigate such relationships in infancy, as mother-child interactions at this early age may set the stage for later child socioemotional development as well as children's own sleep in infancy (Hiscock, 2010; Sadeh, Tikotzky, & Scher, 2010), early childhood (Bordeleau, Bernier, & Carrier, 2012) and beyond (Bell & Belsky, 2008).

The Current Study

Prospective relationships between maternal anxiety, maternal sleep, and parenting behaviors in infancy remain unclear. Further, a deepened understanding of the longitudinal time course of these phenomena – and their potential overlap and influence on one another – is needed. To our knowledge, no study to date has examined prospective longitudinal associations between these three factors in concert during the postpartum period. The current study will thus leverage a sample of African American mothers of 3-, 6-, and 12-month old infants (n = 107) to explore patterns of maternal anxiety, sleep, and positive and negative parenting behaviors across the postpartum period. An increased understanding of the time course of each of these phenomena – and their potential overlap and influence on one another – would inform interventions for maternal sleep, anxiety, and parenting behaviors in the postpartum period. Lastly, the current study utilizes a sample of mothers and their children that is 100% African American. African American mothers tend to experience poorer sleep quality in the postpartum

than do their European American counterparts, irrespective of socioeconomic status (SES) (Mezick et al., 2008; Pigeon et al., 2011). Despite documented disparities in African American women's sleep, research on these mothers that adopts a psychological perspective of sleep (i.e., sleep in the context of maternal *psychological* characteristics, outside of infant sleep, for example) remains scarce. Of the studies on African American mothers that do explore maternal sleep as it relates to maternal psychological functioning and/or parenting, the extant work is qualitative (Zambrano et al., 2016; Doering, 2013). While undoubtedly informative, the authors of these studies call for a fuller body of research. The quantitative examination of a population for whom sleep and its outcomes (e.g., parenting behaviors) may be particularly salient is therefore both theoretically and clinically important.

The current study employs an exploratory longitudinal approach to examine pathways of anxiety, sleep, and parenting behaviors over the course of the postpartum period. We seek to 1) replicate known associations between anxiety and sleep in postpartum women in a sample of African American mothers, and 2) understand how these predictor variables (anxiety symptomatology and sleep quality) may impact positive and negative parenting behaviors displayed in infancy. The specific hypotheses to be tested are as follows:

Hypothesis 1 (Exploratory): Using hierarchical linear modeling analyses, we will conduct descriptive analyses to investigate the trajectories of maternal anxiety, sleep, and positive and negative parenting behaviors from 3- to 12-months postpartum.

Hypothesis 2a: Based on the extant literature, we predict strong associations between maternal anxiety and maternal sleep at 3, 6, and 12-months postpartum.

Hypothesis 2b: We propose that anxiety symptomatology at 3- and 6-months postpartum will predict diminished maternal sleep quality at 6 and 12-months postpartum, respectively.

Hypothesis 3: Lastly, based on extant research that suggests that sleep may also drive of parenting behaviors, we predict that maternal sleep quality at 6-months postpartum will mediate associations between maternal anxiety at 3-months postpartum and parenting behaviors at 12-months postpartum.

Methods

Participants

This study utilized a prospective, longitudinal design to examine a sample of 107 women and their infants. Pregnant, healthy mothers were recruited from Grady Memorial Hospital and Emory University Hospital – Midtown to participate in a study investigating the potential impacts of prenatal stress and environmental exposures on maternal and child health. Mothers participating in the original prenatal outcomes study were informed that there would be additional opportunities to participate in a related follow-up study shortly after the birth of their infants. Thus, within 72 hours of infants' birth, mothers were asked whether they would like to continue their participation through enrollment in a follow-up study on their infant's development from birth to 18-months. To be included in the current study, infants were required to be singletons and to be typically developing at birth (i.e., no evidence of congenital birth defects). Infant age was calculated using corrected gestational age, therefore accounting for pre-term birth. Participating mothers' ages ranged from 18 to 40 years old (M = 24.96, sd = 4.94). A small proportion of mothers were married (13.5%), but 46.2% of mothers reported cohabitating with a romantic partner, regardless of their marital status. All mothers were African American (100%) with a median education level of high school degree or General Educational Development (GED). All demographic information (see *Table 1*) was collected at the prenatal visit and all 3-month postpartum visits occurred within one year of the prenatal visit.

Procedure

Mothers and their infants completed home or lab visits – lasting roughly two hours – when infants were 3-, 6-, and 12-months old. The decision to complete visits at participants' homes versus the lab was dictated by participants' choice and convenience, but researchers first offered the home visit as being preferable. This suggestion was intended to ensure mother-infant dyads were comfortable and thus increase the ecological validity of study findings. The majority of participants completed a home visit at 3-months (84.3%), 6-months (78.6%), and 12-months (76.2%). Notably, Independent Samples T-Tests revealed that there were significant differences among participants in both demographic and study variables based on location of study visit (see *Preliminary Analyses and Covariates* section).

Following informed consent procedures, mothers completed self-report questionnaires on anxiety, sleep, and demographic information. Next, mothers and their infants participated in a 5-minute "unstructured" mother-child interaction task. When infants were both 3- and 6-months of age, no toys were provided to dyads for play, and infants sat in an upright play seat. Mothers were encouraged to leave their child in the play seat for standardization purposes unless their child grew inordinately distressed. At 12-months of age, infants were permitted to sit freely on the floor, and mothers and their infants were provided with a noise-producing shape sorter to explore. At all study timepoints, mothers and their infants were instructed to play as they would normally, and researchers filmed the interaction task using two handheld video cameras. The first camera focused primarily on the mother, while the second focused primarily on her infant.

Measures

Maternal Postpartum Anxiety. Postnatal symptoms of anxiety were assessed using summary scores from the *State-Trait Anxiety Inventory* (*STAI*), *S-Anxiety Scale* (Spielberger et

al., 1983). Mothers completed this 20-item self-report scale at each study visit (i.e., 3-, 6-, and 12-months) and were asked to decide whether statements referencing either the presence or the absence of anxiety described them "*not at all*," "*somewhat*," "*moderately so*," or "*very much so*." The current study utilized the "S" or State-Anxiety scale as a means of evaluating how mothers felt "right now, at this moment." Scores on the S-Anxiety scale range from 20 to 80, with scores greater than or equal to 40 suggesting clinically significant anxiety symptoms (Julian, 2011). The distinction in scale usage (versus the "T" or Trait scale) is important to note, as the S-scale is meant to reflect "transitory states" of anxiety, whereas the corresponding STAI T-Scale investigates overall dispositional proneness to anxiety. As a result, the S-Anxiety Scale has lower test-retest reliability than its T-Scale counterpart. Spielberger et al. (1983) assert the importance of this distinction, explaining that the S-Scale is clinically well-suited to detect change in anxiety over time. Thus, lower test-retest reliability on the S-Scale is informative, expected, and clinically meaningful. Concerning other psychometric properties, the STAI has been shown to have high internal consistency, and good concurrent, convergent, discriminative, and construct validity in both clinical and non-clinical samples (Spielberger et al., 1983). Internal consistencies in the current study sample were adequate: Cronbach's alpha = 0.672 at 3-months, 0.806 at 6-months, and 0.777 at 12-months postpartum.

While there is decidedly less validation of psychological measures in the postpartum period as a whole, the STAI S-Scale appears to have adequate psychometric properties for postpartum women (Meades & Ayers, 2010; Tendais et al., 2014). Given the well-used nature of the STAI S-Scale, various researchers have presented norm ranges for postpartum women. In a community study of women at 3.5 and 7.5 months postpartum, Stuart et al. (1998) proposed normed averages of 30.43 (10.34) and 31.17 (9.91), respectively. Similarly, Grant, McMahon &

Austin (2008) reported norms for women at 7.5 months postpartum with a verified anxiety diagnosis (mean = 45.72, sd= 12.26) and without (mean = 33.32, sd = 8.73). Importantly, these studies were conducted with a majority of European American participants. The literature suggests that there is low internal consistency among STAI scores of European American and African Americans, so these norms should be interpreted with caution in the current study. However, the STAI S-Scale has been previously utilized with pregnant African American women (Jallo et al., 2015) and African Americans more broadly (Williams et al., 2012). Furthermore, when used in an all-African American sample (as done in the current study) internal consistency appears high (Williams et al., 2012).

Importantly, Form Y of the STAI (updated from Form X) was utilized in the current study. Certain items from Form X (a previous iteration) were thought to have better represented depressive symptoms (e.g., "*I feel regretful*") as opposed to anxiety symptoms, and have since been re-worded (e.g., "*I feel strained*") on Form Y for purposes of construct validity. Because the literature is mixed with respect to the ability of the STAI to discriminate anxiety symptoms from depressive symptoms (Kennedy et al., 2001), we included depression in relevant analyses. To do so, we utilized maternal self-report scores from the *Edinburgh Postnatal Depression Scale* (EPDS) (Cox, Holden & Sagovsky, 1987). The EPDS has good internal consistency and construct validity in African American postpartum women (Yonkers et al., 2001; Tandon et al., 2012; Doe et al., 2017). In the current study sample, internal consistency was adequate: Cronbach's alpha = 0.882 at 3-months, 0.886 at 6-months, and 0.867 at 12-months postpartum.

Maternal Sleep. We did not include objective measures of sleep in the current study; however, actigraphy and sleep logs can prove difficult to implement in new mothers (Hunter, Rychnovsky, & Yount, 2009). Instead, maternal self-report of sleep was gathered through

personal responses to the *Pittsburgh Sleep Quality Index* (PSQI) (Buysse et al., 1989). The PSQI includes seven subscales intended to capture the fundamental components of sleep in the past month. Scores on these subscales range from 0 to 3 and the overall range of scores is 0 to 21. The majority of studies that utilize the PSQI also consider the global index of sleep (a summary subscale) of 5 or more as meaningfully "poor" sleep. This widely-used decision point corresponds with a sensitivity of 89.6% and a specificity of 86.5% (Buysse et al., 1989). The PSQI has been validated in pregnant women (Qiu et al., 2016, Zhong, 2015), and utilized with pregnant African American women (Blair et al., 2015) and African Americans more broadly (Buysse et al., 2008), but it has not been validated in postpartum women, despite its frequent use in the extant literature.

Of the PSQI subscales, we selected four subscales *a priori*, in line with our hypotheses, 1) subjective sleep quality, 2) daytime dysfunction, 3) sleep duration, and 4) the global index of sleep. Huang et al. (2004) previously found that depressed mothers at 3 weeks postpartum endorsed items suggesting more significant daytime dysfunction and decreased sleep duration than non-depressed mothers. Given the well-documented high comorbidity between depression and anxiety, we selected these subscales for our research questions as well. We also included subjective sleep quality and the PSQI's global index of sleep in our analyses. The latter allows us to situate our work within the broader sleep literature and provide data for future meta-analyses. This methodological consideration is also in line with general research support that overall sleep quality tends to suffer for both women in the postpartum period and for women experiencing depression and anxiety. Indeed, the secondary goal of this study aims to replicate the results of previous studies that have found relationships between maternal sleep and anxiety postnatally (Okun et al., 2018, Creti et al., 2017). In both cases, these studies found that poorer self-reported

sleep quality and poorer daytime functioning due to fatigue were related to anxiety symptoms at 2- and 6-months postpartum, respectively.

Parenting Behaviors. An adapted version of the Three-Bag Assessment (Brady-Smith et al., 1999) was used to rate a five-minute videotaped interaction between mother-infant dyads when infants were 12-months of age. This coding scheme is publicly available for reference (http://policyforchildren.org/). For the purposes of the current study, we utilized ratings of Maternal Sensitivity, Maternal Positive Regard, Maternal Negative Regard, Maternal Intrusiveness and Infant Negativity. Ratings for each variable fall on a Likert-type scale and range from 1 to 4 points, where "1" suggests little to no evidence of the variable of interest, and "4" represents the highest relative demonstration of said variable. Coders included trained undergraduate research assistants, all of whom were blind to levels of maternal sleep quality and maternal psychological functioning. A trained graduate student researcher completed periodic reliability analyses on 20% of all previously-rated data. Inter-rater reliability was determined by intra class correlations and was greater than or equal to 81% for all study variables of interest.

Given high correlations between Sensitivity and Positive Regard at 3- months ($r = 0.59$, $p < 0.001$), 6-months ($r = 0.45$, $p < 0.001$), and 12-months ($r = 0.67$, $p < 0.001$), we collapsed these domains into a Positive Parenting variable. Similarly, given high correlations between Intrusiveness and Negative Regard at 3-months ($r = 0.54$, $p < 0.001$), 6-months ($r = 0.26$, $p = 0.03$), and 12-months ($r = 0.64$, $p < 0.001$) we collapsed these domains into a variable for Negative Parenting. All collapsed scores thus resulted in a minimum score of 2, and a maximum score of 8, wherein 8 indicates the numerical apex of demonstrations of both Positive and Negative Parenting behaviors. Infant Negativity was also assessed during the mother-infant interaction to measure infants' negativity toward their mothers on a scale from 1 to 4 (low to

high). Inclusion of this construct as a covariate is based on knowledge that infant temperament can affect the quality of mother-infant interactions (Newland et al., 2016; Wittig & Rodriguez, 2019).

Preliminary Analyses and Covariates

We first conducted Independent Samples T-tests to explore differences in study variables based on visit location. Due to unequal sample sizes between groups (i.e., an overwhelming majority of study participants selected the home visit in favor of the lab visit), Levene's Test for Equality of Variances was violated. As such, equal variances were not assumed when interpreting the following results. At all study time points, mothers who selected the home visit option tended to be older (t = -2.62, p = 0.02; t = -3.11, p < 0.01; t = -3.11, p = 0.01), and have a higher education level (t = -2.61, p = 0.02; t = -3.50, p < 0.01; t = -4.44, p < 0.01). At 3-months, mothers who selected the home visit option were more likely to be married (t = -3.19, p < 0.01) and had elevated STAI scores, on average (t = -2.70, p = 0.01; home visit mean = 32.67, sd = 11.87; lab visit mean = 26.85, sd = 5.87). At 6-months, mothers who selected the home visit option were more likely to be married (t = -3.41, p < 0.01) and living with their partner (t = -2.22, p = 0.03) In addition, these mothers tended to sleep fewer hours per night than mothers who completed the lab visit option (t = 2.16, p = 0.04; home visit mean = 6.73 hours, sd = 1.77; lab visit mean = 8.06 hours, sd = 2.42). Aside from age and education level (mentioned previously), at 12-months postpartum there were no differences in study variables between participants based on location of visit. Finally, T-tests suggested no differences in parenting behaviors based on location of visit at any study timepoint.

Demographic factors that have previously been associated with the study outcome variables were investigated as potential covariates separately at each study timepoint. These

included the following maternal variables: age, marital and relationship status, education level, income level, and number of people in the household. With respect to infant variables, we tested for the following potential covariates: sex, age, and infant negativity. Infant sleep was not included as a covariate as its inclusion was beyond the scope of the current study.

At 3-months, married mothers tended to report increased anxiety ($r = 0.24$, $p = 0.03$), and poorer subjective ($r = 0.24$, $p = 0.03$) and total sleep quality ($r = 0.27$, $p = 0.01$) compared to unmarried mothers. In addition, older maternal age was associated with increased daytime dysfunction ($r = 0.23$, $p = 0.04$), and poorer total sleep quality ($r = 0.27$, $p = 0.02$). Older maternal age ($r = 0.27$, $p = 0.02$) and higher education level ($r = 0.24$, $p = 0.05$) were associated with increased positive parenting behaviors. In addition, infant age was associated with total maternal sleep quality, such that mothers of younger infants reported poorer total sleep quality ($r = -0.24$, $p = 0.03$). Infant negativity was associated with negative parenting behaviors ($r = 0.25$, $p = 0.04$), such that infants who displayed more negativity had mothers who also displayed more negativity. There were no associations between 3-months postpartum outcome variables and any of the remaining covariates: number of people in the household, income, or infant sex.

At 6-months, older mothers reported shorter sleep duration ($r = -0.26$, $p = 0.02$), more daytime dysfunction ($r = 0.27$, $p = 0.02$), and both poorer subjective ($r = 0.29$, $p = 0.01$) and total sleep quality ($r = 0.44$, $p < 0.01$). In addition, higher levels of education ($r = 0.41$, $p < 0.01$) and income ($r = 0.26$, $p = 0.03$) were associated with increased positive parenting behaviors. Older infant age was associated with decreased daytime dysfunction ($r = -0.23$, $p = 0.04$). Increased infant negativity was associated with shorter sleep duration ($r = -0.25$, $p = 0.04$) decreased positive parenting behaviors ($r = -0.32$, $p = 0.01$) and increased negative parenting behaviors ($r = 0.29$, $p = 0.01$). There were no associations between 6-months postpartum outcome variables and

any of the remaining covariates: martial or relationship status, number of people in the household, or infant sex.

At 12-months, married mothers showed decreased negative parenting behaviors (r = -0.31, p = 0.02). In addition, higher maternal education was associated with increased positive parenting behaviors (r = 0.34, p = 0.01). Increased infant negativity was associated with poorer subjective sleep quality (r = 0.35, p = 0.01), and increased negative parenting behaviors (r = 0.46, $p < 0.01$). There were no associations between 12-months postpartum outcome variables and any of the remaining covariates: maternal age, number of people in the household, income, infant sex, or infant age.

Results

Descriptive Statistics

Table 1 displays the sample demographics. To be included in the current study, mothers were required to have completed at least one measure of the study constructs of interest (i.e., anxiety, sleep, or parenting behaviors) at each study timepoint (i.e., 3-, 6-, and 12-months). *Tables 2, 3,* and *4* display descriptive statistics for study variables in the current sample. Mean maternal anxiety symptomatology, as assessed by the STAI, fell below the clinical range, on average. Similarly, mean maternal depressive symptomatology, as assessed by the EPDS also fell below the clinical range, on average. Notably, overall maternal sleep quality, as assessed by the PSQI global index of sleep, was considered "poor," on average.

Descriptive Trajectories of Maternal Anxiety, Maternal Sleep, and Parenting

To address our first hypothesis, Hierarchical Linear Modeling (HLM-7) was used to examine the trajectories of 1) maternal anxiety, 2) maternal sleep, and 3) positive and negative parenting behaviors across all study time points. HLM-7 allows for the use of nested models,

which enables the researcher to examine changes in outcome variables across multiple time points rather than collapsing measures of anxiety, sleep, and parenting behaviors across all mothers within the sample. Importantly, as infants grow from 3- to 12-months of age, maternal characteristics and subsequent mother-infant relationships are subject to developmental change. Thus, when answering a descriptive question, collapsing relationships between outcome variables from 3- to 12-months postpartum would mask these developmental changes. According to HLM-7 assumptions, individuals were removed from study analyses if they were missing data at Level 2 (person level measures that stay constant over time) (Woltman et al., 2012), but were included if data were missing at Level 1 (person level measures that may change over time).

In each empty model [*Outcome variable = Infant Corrected Age + error],* infant corrected age was entered (uncentered) as a Level 1 predictor of each outcome variable. In this way, infant corrected age served as a reference point for change over time. To provide the most conservative estimates possible, robust standard errors were utilized in the final estimation of fixed effects, given small sample sizes and missing data.

Based on final estimation of variance components, maternal anxiety symptomatology did not vary across study timepoints, nor did it vary among individual mothers. Similarly, maternal subjective sleep quality, daytime dysfunction, and total sleep quality did not significantly vary across study timepoints, nor did they vary among individual mothers. In contrast, although average maternal sleep duration remained stable across study timepoints, there was significant variation in this measure among individual mothers (σ^2=0.004, χ^2 (*df*=65) =89.65, *p*=0.02). Negative parenting behaviors also remained stable across study timepoints, with little variation among individual mothers (σ^2=0.003, χ^2 (*df*=54) =71.07, *p*=0.06). Finally, positive parenting behaviors decreased across study timepoints (Coefficient = -0.004, SE = 0.001, t-ratio = -3.58, df

= 96, $p < 0.001$) with significant variation among individual mothers as well (σ^2=0.005, χ^2 (*df*=54) =82.53, *p*=0.008).

Relationships Between Maternal Anxiety and Maternal Sleep Across the Postpartum

Given known relationships between anxiety and sleep in the general population, and recent work demonstrating these relationships in postpartum women, we aimed to replicate these findings at 3-, 6-, and 12-months postpartum. As expected, bivariate correlations at each timepoint (see *Tables 5, 6,* and *7*) revealed consistent relationships between maternal anxiety and three out of four sleep indices measured: subjective sleep quality, daytime dysfunction, and total sleep quality. However, while there were associations between maternal anxiety and sleep duration at 3-months, these associations did not persist at 6- or 12-months. This pattern of results also held when we probed for relationships between maternal depression and the four sleep indices. Taken together, it may be that our metric of maternal sleep duration was less reliable. Indeed, participants' answers to the question "*How many hours of actual sleep do you get at night*?" were at times non-numeric (e.g., "*a lot*," "*not enough*," "*not sure*"). This may have contributed to a lack of significant associations with this variable in particular.

Time-Lagged Analyses Between Maternal Anxiety and Maternal Sleep Across the Postpartum

Next, we conducted hierarchical linear regressions in IBM SPSS (version 25.0) to examine whether maternal anxiety symptomatology at previous timepoints predicted maternal sleep quality at subsequent timepoints, over and above sleep quality at previous timepoints. To fully evaluate our hypothesis, and as a point of comparison, these analyses were also conducted in the opposite direction. That is, with maternal sleep quality predicting to anxiety symptomatology at subsequent timepoints, over and above anxiety symptomatology at previous

timepoints. Given a lack of zero-order correlations between maternal anxiety and sleep duration at 6- and 12-months, we restricted time-lagged regression analyses to relationships between maternal anxiety and only the three following sleep-related outcome variables: subjective sleep quality, daytime dysfunction, and total sleep quality. All significant associations held even after inclusion of relevant covariates. Results are displayed in *Figures 1-3*.

Overall, mothers showed positive autocorrelations between their own anxiety symptomatology, but not consistently with their sleep quality. Specifically, maternal anxiety at earlier timepoints was associated with maternal anxiety at later timepoints. In addition, maternal subjective sleep quality and daytime dysfunction at earlier timepoints were associated with maternal subjective sleep quality and daytime dysfunction at later timepoints, respectively. However, while maternal total sleep quality at 3-months was associated with maternal total sleep quality at 6-months, maternal total sleep quality at 6-months was not associated with maternal total sleep quality at 12-months. This latter finding is unexpected.

Overall, it appears that maternal anxiety symptomatology at earlier timepoints predicts to maternal sleep indices at later timepoints, over and above maternal sleep indices at these earlier timepoints. These results consistently revealed significant positive associations, suggesting that heightened anxiety at earlier timepoints in the postpartum period is linked to poorer sleep (by some metric) at later timepoints in the postpartum period. Analyses indicated one notable exception to this pattern of results. Specifically, maternal anxiety at 6-months was not significant in predicting to mothers' subjective sleep quality at 12-months, over and above their subjective sleep quality at 6-months (*Figure 1*). Despite this exception, in line with our hypothesis, results for time-lagged analyses of each sleep index predicting to maternal anxiety were non-significant.

This suggests that, at least for the indices of sleep investigated here, associations between anxiety symptomatology and sleep are primarily driven by anxiety during the postpartum period.

Sleep as a Mediator of the Relationship Between Anxiety and Parenting Behaviors

Finally, we addressed our last hypothesis, which posited sleep as a potential mediator of the association between anxiety and parenting behaviors. Based on the assumptions for mediation suggested by Preacher & Hayes (2004), we first tested for time-lagged associations between indices of maternal sleep at 6-months postpartum, and positive and negative parenting behaviors at 12-months postpartum. The reasoning put forth by Preacher & Hayes presumes that mediation can be significant even if there is no main effect from the predictor (i.e., maternal anxiety) to the criterion variable (i.e., parenting behaviors). Covariates (i.e., maternal education for positive parenting behaviors; marital status and infant negativity for negative parenting behaviors) were entered in the first block, and maternal sleep indices at 6-months were entered in the second block. Positive or negative parenting behaviors at 12-months postpartum were entered as the dependent variable in separate multivariate linear regression models. Results are displayed in *Tables 8* and *9*.

In general, there was no main effect of maternal sleep on either positive or negative parenting behaviors. However, there was one exception: maternal daytime dysfunction at 6-months postpartum was predictive of increased positive parenting behaviors at 12-months postpartum (see *Table 8*), even when accounting for maternal education as a covariate. This appeared to be an anomaly within our findings, and the direction of the relationship was unexpected. Specifically, worse daytime functioning at 6-months postpartum was associated with increased positive parenting behaviors at 12-months postpartum. Given this finding, we conducted a full mediation analysis using the PROCESS Macro in SPSS (Hayes, 2012). Results

for this mediation analysis were found to be non-significant (β = 0.01, SE= 0.01, 95% CI: [-0.01, 0.04]), suggesting that daytime dysfunction does not in fact mediate associations between maternal anxiety at 3-months postpartum and positive parenting behaviors at 12-months postpartum. Aside from this finding, all other main effects of sleep on parenting behaviors were non-significant. Because of these non-significant effects between the proposed mediator (i.e., maternal sleep) and criterion variables (i.e., positive and negative parenting behaviors), we did not proceed with full mediation analyses with other sleep variables and parenting.

Lastly, it is interesting to note that infant negativity at 6-months postpartum was predictive of negative parenting behaviors at 12-months postpartum. Specifically, higher infant negativity when infants were younger was associated with increased displays of mothers' own negativity 6-months later.

According to the extant literature, maternal anxiety (and maternal depression) typically have associations with parenting behaviors, though the direction and strength of these associations vary depending on the type of parenting being assessed. Although we did not see this represented in bivariate correlations (see *Tables 5, 6,* and *7*), we conducted post-hoc multivariate regression analyses for interaction effects of anxiety and sleep indices at each study timepoint, to probe for their potential associations with parenting. Interaction terms were centered, and covariates were entered appropriately. The results of each of these interactions were non-significant and are not displayed here for purposes of brevity. Taken together, neither maternal anxiety, maternal sleep, nor the interactive effects of maternal anxiety and sleep have associations with parenting behaviors in the current study sample.

Discussion

To our knowledge, this is the first study to examine quantitative associations between maternal anxiety, sleep, and early parenting behaviors in a community sample of African American, postpartum women. Consistent with the extant literature, we replicated associations between maternal anxiety and maternal sleep at three timepoints across the postpartum period. Moreover, we demonstrated that maternal anxiety at earlier timepoints largely predicted indices of maternal sleep quality at later timepoints. More specifically, for this group of mothers, anxiety symptomatology appears to be the driver of sleep quality, as opposed to the contrary. These findings add to the growing body of literature on the associations between psychological functioning and sleep and align well with a growing initiative to situate sleep research within a psychological context (Alvaro, Roberts, & Harris, 2013).

Importantly, African American women tend to report poorer sleep quality than their Non-Hispanic White counterparts (Mezick et al, 2008; Pigeon et al, 2011). Despite this sleep differential, there is a paucity of work that quantifies African American women's sleep *during the postpartum period*. This study helps to address this important gap in the literature. Our results showed that there was little variability in postpartum mothers' subjective sleep quality, daytime dysfunction, and total sleep quality across time. However, there was slight variation in individual mothers' nightly sleep duration (see *Table 3*). While this hypothesis was exploratory in nature, these results were unexpected, as we would have predicted improvements in both maternal sleep quality and maternal sleep duration. Improvements in maternal sleep from 3- to 12-months postpartum are to be expected, as infant sleep tends to consolidate by 6-months postpartum (Jenni & Carskadon, 2012). As the days pass and infants sleep more soundly, mothers also grow more accustomed to motherhood, and may be defter at managing daily stress and sleeping well regardless. However, observed improvements in mothers' sleep quality were

not statistically significant in the present study. It is feasible that, due to our smaller sample size and high attrition rate, HLM could not adequately capture the improvements in maternal sleep suggested by visual inspection of our descriptive statistics. However, we did follow sample size guidelines put forth by McCoach (2010) (i.e., a minimum $n = 100$ at Level 2), which suggests that mothers' sleep was generally stable across the postpartum period. This is informative in and of itself, as it suggests that mothers' sleep was not improving in a linear fashion, even as their infants (should) sleep longer, and as they increasingly adjust to motherhood. We might re-frame the idea that maternal sleep solely warrants intervention if it is worsening over time. Instead, maternal sleep might also warrant intervention *if it is not improving* over time. Future work with a larger sample of mothers will allow us to tease this apart and make recommendations for maternal sleep interventions accordingly.

A major strength of the current study was our replication of cross-sectional associations between maternal anxiety and maternal sleep, as well as our finding that maternal anxiety at earlier timepoints largely predicted maternal sleep at later timepoints. While maternal anxiety symptomatology remained stable over time, its associations with maternal sleep were robust. This pattern of results suggests meaningful relationships between maternal anxiety symptomatology and maternal sleep, despite our use of a community sample of mothers who did not tend to endorse symptoms of anxiety in the clinical range (see *Table 2*). We predict that these associations would be even stronger in a clinical sample of postpartum mothers. Importantly, these results have implications for clinical interventions. In particular, our findings suggest that intervening on maternal anxiety symptomatology in the early postpartum might have downstream effects on maternal sleep quality in the later postpartum. Sleep interventions themselves are important for reducing maternal psychopathology (Lawson et al., 2015), but the

alternative, opposite approach might also be taken. Indeed, the National Perinatal Association notes that when maternal mood suffers, so too do sleep disturbances (2018). Reduction of mood symptomatology in and of itself is certainly important, but its cascading influence on other life areas (e.g., maternal sleep) is not to be overlooked. For instance, many mothers seeking treatment for postpartum anxiety report that they are unable to sleep when their infants are sleeping, because they are preoccupied by their own feelings of worry (Umylny, German, & Lantiere, 2017). Clinical interventions for postpartum mood disorders might therefore expand their purview, in order to consider associations with maternal sleep quality as well.

It is of note that analyses run with maternal depressive symptoms in place of maternal anxiety yielded similar relationships. In fact, research suggests that even our measure of anxiety (the STAI) does not consistently discriminate symptoms of anxiety from symptoms of depression (Kennedy et al., 2001). Relatedly, a parallel body of research suggests that our measure of depression (the EPDS) may also fail to discriminate between anxiety and depression (Jomeen & Martin, 2007; Matthey, 2008). The EPDS includes three items that seem to load onto an anxiety subscale (e.g., "*I have blamed myself unnecessarily when things went wrong," "I have been anxious or worried for no good reason,"* and *"I have felt scared or panicky for no good reason."* Given the noted inconsistencies between both the STAI and the EPDS, a promising future direction would be the inclusion of diagnostic interviews of maternal psychological functioning, as these are thought to be the gold standard (Fairbrother et al., 2016). While the current study is focused on the predictive utility of maternal postpartum anxiety, it may be that maternal psychological distress more broadly is a better predictor of study outcomes (e.g., sleep difficulties, parenting behaviors). Subclinical rates of anxiety are common among women, and it may be that information gleaned from the STAI is not adequately capturing these nuanced

symptom profiles (Nolen-Hoeksma, Larson, & Grayson, 1999; Hankin, 2009). Similarly, because African American women tend to underreport symptoms of both depression and anxiety (Watson & Hunter, 2015), less stigmatized and more generalized self-report questionnaires such as the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) might be utilized in future work. All things considered, a major strength of the current study was our direct exploration of maternal psychological functioning alongside maternal sleep. Maternal mental illness is often considered an exclusionary criterion in sleep studies (see Doering, 2013). Contingent on the research question of interest, this may be a warranted methodological approach, but in many cases, removal of indices of maternal psychological functioning may obscure meaningful relationships with the construct of sleep.

Finally, a major aim of the current study was to explore associations between maternal anxiety, maternal sleep, and parenting behaviors. Our findings revealed decreases in positive parenting behaviors from 3- to 12-months postpartum, but suggested stability in negative parenting behaviors, despite some interindividual variability among mothers. These descriptive analyses suggested that some factor or set of factors were having an impact on maternal parenting behaviors, consistent with our hypothesis. However, indices of maternal sleep were unrelated to parenting behaviors, despite an extant body of research that suggests the opposite (see Meltzer & Mindell, 2007; Cooklin, Giallo, & Rose, 2011; Sinai & Tikotzky, 2012; Chau & Giallo, 2015; Parker White et al., 2015, among others). Our pattern of findings cannot be explained on the basis of "good sleep," as mothers in our sample tended to have "poor" sleep, on average. The majority of studies that report significant associations among these variables have been conducted with mothers of older children, suggesting that sleep quality is perhaps more relevant when parenting a toddler, or school-aged child. Perhaps the more active parenting

practices elicited by older children necessitate a better night's sleep from mothers. In contrast, parenting behaviors in infancy might be less involved and therefore more easily performed on less sleep. Or, it may be that due to societal expectations associated with caregiving in infancy, parenting and a good night's sleep are viewed as somewhat incompatible. Similarly, parents may re-calibrate their expectations for their own sleep as their children age, such that parents of older children are surprised and frustrated when their sleep suffers, as this is typically associated with parenting in infancy.

As for maternal anxiety, our results were also not consistent with the wide body of literature that suggests relationships between maternal anxiety and parenting behaviors (see Kaitz & Maital, 2005; Nicol-Harper et al., 2007; Feldman, 2009; Seymour et al., 2014, among others). In the current study, there were no associations between maternal anxiety and parenting behaviors, either cross-sectionally or longitudinally (data not shown). To account for the fact that maternal depressive symptoms may have been a better predictor of parenting behaviors (Goodman et al., 2011), we repeated these analyses with maternal depression as a predictor. A similar pattern of results was found, suggesting that maternal internalizing disorders are wholly unrelated to parenting behaviors in the current study sample. Boyd, Zayas, & McKee (2006) found a similar pattern of results in a sample of minority women (42% African American). These authors explained their unexpected findings by suggesting that – similar to our sample of minority women– women's scores were not in the clinical range of psychological functioning, and were thus not adequate predictor variables. As mentioned previously, African American women tend to underreport psychological complaints (Watson & Hunter, 2015), so it may be that women's reluctance and research demand characteristics may have masked associations with parenting behaviors.

In the current study sample, positive and negative parenting behaviors were more likely to be associated with demographic factors (e.g., maternal age, marital status, education, and income level) than with proposed predictor variables. These associations may be problematic, in that they suggest that raters of mother-infant interactions may have shown biases towards mothers of high SES backgrounds. While income level was positively associated with positive parenting behaviors only at 6-months, education level is often seen as a proxy of income (Galobardes et al., 2006). Higher maternal education was associated with increased positive parenting behaviors at all study timepoints. Given that the majority of study visits occurred in participants' homes, it may be that raters were liable to differences in their ratings of positive parenting, based on the appearance of not just mothers, but also families' overall home environment. Standardization of mother-infant interactions might be achieved through a lab visit-only protocol. To explore this possibility, we selected for dyads who completed lab visits at 12-months, and conducted post-hoc bivariate correlations between all study variables. Positive parenting behaviors showed no associations with either maternal anxiety (or depression) or indices of sleep quality. However, increased negative parenting behaviors were associated with worse maternal subjective sleep quality ($r = 0.63$, $p = 0.02$). This single finding is more in line with our initial prediction, that parenting behaviors are hindered by sleep deficits. However, there were no additional associations between negative parenting behaviors and maternal anxiety (or depression) or sleep quality indices. Interestingly, associations between demographic variables suggestive of SES (e.g., education, income) were no longer significantly associated with either type of parenting behaviors in the subsample who completed the study in the lab, which supports the idea that a standardized setting such as a lab might eliminate rater biases. Unfortunately, only $n = 15$ mothers and their infants completed lab visits at 12-months, so these

results should be interpreted with caution. Regardless, as recruitment of study participants continues, additional analyses might do well to consider the impact of visit location on parenting behaviors.

Interestingly, older mothers demonstrated greater positive parenting behaviors at the 3-month visit, and married mothers demonstrated fewer negative parenting behaviors at the 12-month visit. Our participating mothers were relatively young (mean age = 24.96 years, sd = 2.94), with some mothers as young as 18-years-old. There is some research suggesting that younger maternal age is associated with observable decreases in supportiveness, and increases in detachment, intrusiveness, and negativity towards infants (Berlin, Brady-Smith, & Brooks-Gunn, 2002). Our finding that marital status reduces the instances of negative maternal parenting behaviors is similar to that of McFadden & Tamis-Lemonda (2012). Marital status may indicate social support, and social support may serve as a buffer for one's wellbeing. Mothers' wellbeing may trickle down to their interactions with their children. While few mothers in our sample were married (13.5%), this social support appears to have been nonetheless impactful at 12-months postpartum. It may be that as infants age, and require more complex parenting behaviors, additional social support from a spouse or committed partner may become increasingly important in executing said parenting behaviors.

While demographic variables may explain some of the variance in both positive and negative parenting behaviors, infant-specific variables should also be considered as relevant drivers of maternal behaviors. Indeed, there were noted associations between infant negativity and negative parenting behaviors at each study timepoint. Infant negativity was assessed during the context of the mother-infant interaction and was operationalized as negativity expressed towards the mother. It seems logical then, given the very word *interaction,* that we see these

positive associations (see *Tables 5, 6,* and *7*). Causality cannot be established in the present study, but bidirectionality is reasonable, and may be explored in future time-lagged analyses. Perhaps mothers with crying or fussy infants are more prone to demonstrate parental frustrations. Alternatively, it may be that maternal negativity (e.g., intrusive overtures, negative tone of voice, etc.) may stimulate infants' own negativity (St. James-Roberts, Conroy, & Wilsher, 1998; Thomas et al., 2017). Future studies might conduct contingency analyses, or utilize the Actor-Partner Interdependence Model (Fitzpatrick et al., 2016) to tease the directionality of these associations apart. Observed mother-infant interactions provide us with a rich *in vivo* context in which to do so, and this is a major strength of the current study dataset. Evidence of directionality (i.e., maternal-driven negativity versus infant-driven negativity) would inform parenting interventions in infancy. For instance, Hane et al. (2006) demonstrated that mother-observer agreement is high on obvious displays of infant negativity, but that mothers tend to have trouble identifying more subtle displays of infant negativity. Mothers may be coached on emotion regulation of their own negativity when faced with a negative child, but delivery of these interventions may differ depending on directionality and type.

In addition, infant negativity had associations with indices of maternal sleep. Specifically, at 6-months postpartum, infant negativity was associated with shorter maternal sleep duration (r = -0.25, p = 0.04), and at 12-months postpartum, infant negativity was associated with poorer maternal subjective sleep quality (r = 0.35, p = 0.01) (see *Tables 6* and *7*). Taken together, it appears that infant negativity has associations with maternal sleep that are similar to maternal parenting behaviors. An infant more prone to displays of negativity may have a mother who is more prone to both poor sleep and her own displays of negativity. Future work might explore whether indirect effects models are feasible, wherein infant negativity mediates associations

between maternal sleep and parenting behaviors. Indeed, infant negativity does show positive associations with maternal fatigue in the early postpartum period (Rychnovsky, 2007; Loutzenhiser, McAuslan, & Sharpe, 2015). These associations have been noted only in 3- to 6-month infants, but future work with our longitudinal dataset will afford us the strength to explore whether these relationships continue throughout the first year of infancy.

In contrast to negative parenting behaviors, positive parenting behaviors and infant negativity were inversely related only at 6-months postpartum. This suggests that maternal positive parenting behaviors occur (at least at 3- and 12-months postpartum) irrespective of infant negativity. However, it may also be the case that mothers who demonstrated more positive parenting simply had infants who did not display negativity in that particular interaction (e.g., crying, scowling, throwing objects, etc.). Whether mothers modulated that relationship through their own sensitive, positive parenting behaviors such that infants never initiated negativity remains to be seen. If maternal positive parenting is relatively impervious to infant negativity, such results are encouraging. Specifically, they suggest that positive parenting strategies can be effectively used with babies across a wide variety of temperaments. This is heartening, given the effects of positive parenting interventions in infancy and beyond. For instance, Velderman et al. (2006) implemented a positive parenting intervention in infancy, and found that early-life demonstrations of maternal sensitivity were associated with less externalizing problems when children reached preschool. Similarly, in a sample of children followed from birth to age 32, sensitive, positive parenting in infancy was associated with later teacher and peer ratings of higher social competence, as well as with higher romantic relationship satisfaction in young adulthood (Raby et al., 2015). Interestingly, infants' own receipt of positive, sensitive parenting

in infancy was related to their own demonstrations of positive parenting years later. Taken together, positive parenting may be capable of powerful, intergenerational effects.

Lastly, a limitation of this study was a lack of measurement of infant sleep. Infant sleep itself has associations with infant negativity (Loutzenhiser & Sevigny, 2008), maternal anxiety (Morales-Munoz et al., 2018), maternal sleep (Dennis & Ross, 2005; Thomas & Foreman, 2005), and parenting behaviors (St. James-Roberts et al., 2017). For instance, parents of infants who are less well-rested appear to be less tolerant of their infants' negativity (Sadeh et al., 2016), and may therefore demonstrate less positive, sensitive parenting (Philbrook & Teti, 2016). The inclusion of infant sleep as a predictor of maternal psychological functioning, maternal sleep, and parenting behaviors is an important future direction. However, the main goal of the current study was to examine *maternal* sleep, as it has been somewhat neglected in the postpartum literature to date (Doering et al., 2013; Zambrano et al., 2016).

As African American women tend to experience the worst sleep quality of any group, these women represent an especially worthwhile target for sleep quality research in the postpartum period. The current study demonstrated through time-lagged analyses that mitigating psychological distress (e.g., maternal anxiety) in these new mothers may serve to improve their later sleep quality. Inconsistent with the extant literature, the current study failed to demonstrate relationships between either maternal anxiety or maternal sleep and maternal parenting behaviors. Future directions might include alternative indirect effects models wherein infant negativity and infant sleep influence parenting behaviors in the postpartum period. The current study advances our knowledge on the effects of maternal psychological functioning on sleep in a sample of postpartum, minority women and their infants. Ongoing work will allow us to gain a fuller picture of maternal and infant well-being in the postpartum period.

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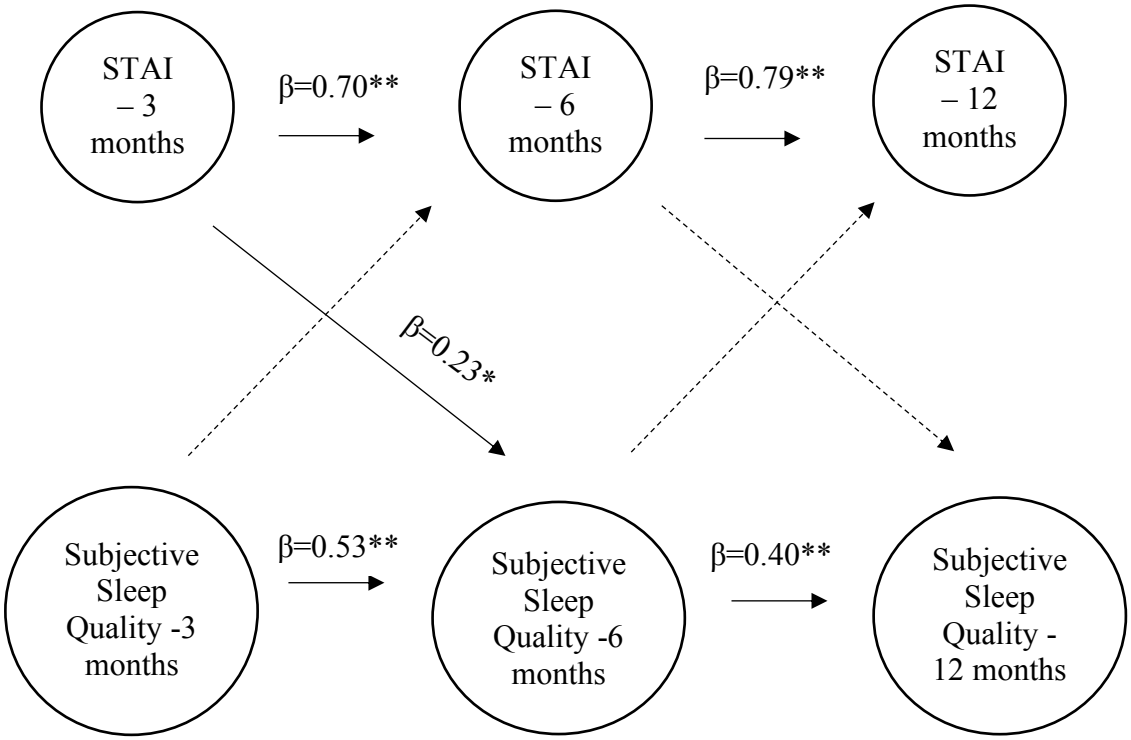
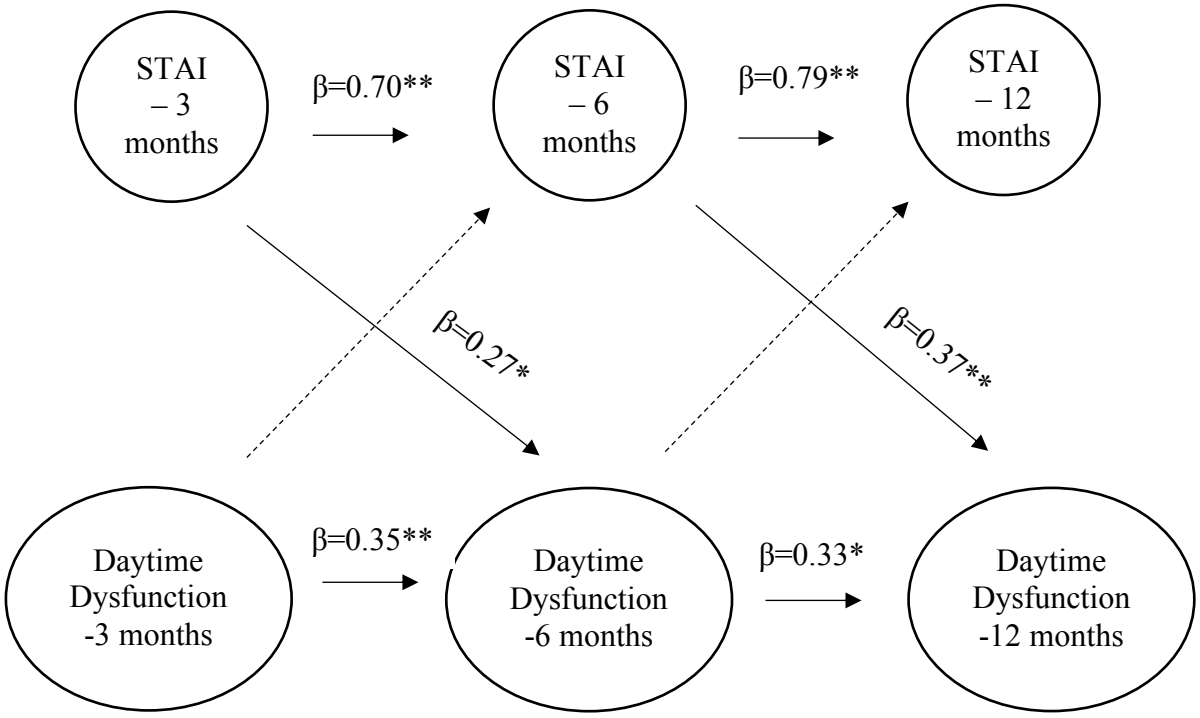
Figure 1. Results from time-lagged analyses for Maternal Anxiety and Subjective Sleep Quality



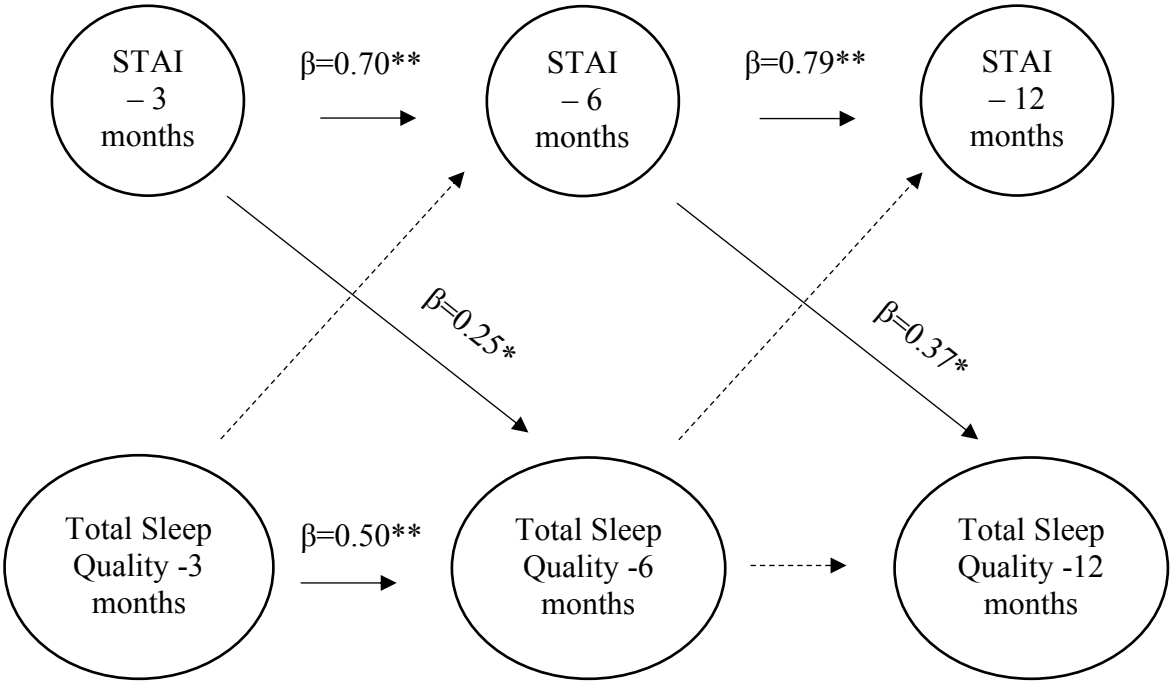
Note. Betas displayed account for relevant covariates. ** $p < 0.01$, * $p < 0.05$.

Figure 2. Results from time-lagged analyses for Maternal Anxiety and Daytime Dysfunction



Note. Betas displayed account for relevant covariates. ** $p < 0.01$, * $p < 0.05$.

Figure 3. Results from time-lagged analyses for Maternal Anxiety and Total Sleep Quality



Note. Betas displayed account for relevant covariates. ** $p < 0.01$, * $p < 0.05$.

Table 1. Sample Demographics

Variable	M (SD) or %	Range
Maternal Age	24.96 years (4.94)	18 - 40
Maternal Ethnicity, %	100% African American	-
Married	13.5%	-
In a Relationship	23.1%	-
In a Relationship and Cohabitating	46.2%	-
Number of People in the Household, including mother	3.16 (1.31)	1-7
Maternal Education		
Some High School	9.6%	-
Graduated High School or GED	44.2%	-
Some College or Technical School	30.8%	-
Graduated College	8.7%	-
Some Graduate Work or Degree	6.7%	-
Maternal Income		
< 100% of the Federal Poverty Level	46.9%	-
100-132% of the Federal Poverty Level	11.2%	-
133-149% of the Federal Poverty Level	5.1%	-
150-199% of the Federal Poverty Level	19.4%	-
200-299% of the Federal Poverty Level	6.1%	-
300-399% of the Federal Poverty Level	5.1%	-
> 400% of the Federal Poverty Level	6.1%	-
Infant Sex	61 males (57.0%)	-
Infant Age, 3-months*	96.75 days (16.10)	53 -152 days
Infant Age, 6-months*	191.90 days (22.30)	137 - 281 days
Infant Age, 12-months*	372.85 days (23.46)	313 - 472 days

Note. Infant Age represents corrected gestational age, accounting for pre-term birth.

Table 2. Maternal Anxiety (STAI-S) and Depression (EPDS) Symptomatology

Psychological Construct	M (SD)	Range	N (% Total Sample)
Maternal Anxiety, 3-months	31.76 (11.32)	20-75	83 (77.57%)
Maternal Anxiety, 6-months	33.33 (11.17)	20-63	82 (76.64%)
Maternal Anxiety, 12-months	30.46 (10.15)	20-60	61 (57.01%)
Average Maternal Anxiety (3- to 12-months)	31.83 (10.49)	20-67.50	107 (100%)
Maternal Depression, 3-months	6.33 (6.09)	0-29	83 (77.57%)
Maternal Depression, 6-months	5.65 (5.77)	0-25	82 (76.64%)
Maternal Depression, 12-months	5.11 (4.83)	0-18	61 (57.01%)
Average Maternal Depression (3- to 12-months)	5.64 (5.15)	0-21.67	107 (100%)

Note. STAI scores of greater than or equal to 40 suggest clinically significant anxiety. EPDS scores of greater than or equal to 13 suggest clinically significant depression, but scores of 10 or more have been suggested for African American populations (Chaudron et al., 2010; King, 2012).

Table 3. Maternal Sleep (PSQI) Characteristics

Sleep Feature	M (SD)	Range	N (% Total Sample)
Maternal Sleep Duration (hours), 3-months	6.42 (1.89)	3-12	80 (74.76%)
Maternal Sleep Duration (hours), 6-months	7.03 (1.99)	0-12	80 (74.76%)
Maternal Sleep Duration (hours), 12-months	6.82 (1.46)	3-10	60 (56.07%)
Average Maternal Sleep Duration (hours) (3 to 12-months)	6.77 (1.50)	3.25-12	105 (98.13%)
Maternal Subjective Sleep Quality, 3-months	0.99 (0.83)	0-3	81 (75.70%)
Maternal Subjective Sleep Quality, 6-months	0.92 (0.75)	0-3	79 (73.83%)
Maternal Subjective Sleep Quality, 12-months	0.88 (0.62)	0-2	58 (54.21%)
Average Maternal Subjective Sleep Quality (3 to 12-months)	0.91 (0.68)	0-3	106 (99.07%)
Maternal Daytime Dysfunction (3-months)	0.55 (0.85)	0-3	82 (76.64%)
Maternal Daytime Dysfunction (6-months)	0.66 (0.80)	0-3	82 (76.64%)
Maternal Daytime Dysfunction (12-months)	0.39 (0.61)	0-2	61 (57.01%)
Average Maternal Daytime Dysfunction (3 to 12-months)	0.53 (0.67)	0-3	107 (100%)
Maternal Total Sleep Quality (3-months)	6.18 (3.50)	1-19	82 (76.64%)
Maternal Total Sleep Quality (6-months)	5.55 (3.46)	0-19	82 (76.64%)
Maternal Total Sleep Quality (12-months)	4.87 (2.94)	0-17	61 (57.01%)
Average Maternal Total Sleep Quality (3 to 12-months)	5.60 (3.04)	0.67-19	107 (100%)

Note. Maternal Total Sleep Quality scores of greater than or equal to 5 suggest “poor” sleep.

Table 4. Parenting Behaviors and Infant Negativity

Observer Rated Maternal/Infant Behaviors	M (SD)	Range	N (% Total Sample)
Positive Parenting, 3-months	6.69 (1.36)	3-8	72 (67.29%)
Positive Parenting, 6-months	6.46 (1.37)	2-8	74 (69.16%)
Positive Parenting, 12-months	5.74 (1.65)	2-8	57 (53.27%)
Negative Parenting, 3-months	2.89 (1.18)	2-7	72 (67.29%)
Negative Parenting, 6-months	3.08 (1.13)	2-6	74 (69.16%)
Negative Parenting, 12-months	2.88 (1.20)	2-6	57 (53.27%)
Infant Negativity, 3-months	2.01 (1.11)	1-4	72 (67.29%)
Infant Negativity, 6-months	1.92 (1.11)	1-4	74 (69.16%)
Infant Negativity, 12-months	1.30 (0.63)	1-4	57 (53.27%)

Note. Parenting Behaviors were rated during the Mother Child Interaction. Positive Parenting is comprised of Maternal Sensitivity and Maternal Positive Regard, and Negative Parenting is comprised of Maternal Intrusiveness and Maternal Negative Regard. Infant Negativity ratings are stand-alone scores, thus accounting for the differences in ranges for maternal and infant interaction behaviors.

Table 5. Bivariate Correlations Between Outcome Variables at 3-Months Postpartum

		1	2	3	4	5	6	7	8
1.	Maternal Anxiety	-							
2.	Maternal Depression	$r = 0.74$**	-						
3.	Maternal Sleep Duration	$r = -0.33$**	$r = -0.31$**	-					
4.	Maternal Subjective Sleep Quality	$r = 0.38$**	$r = 0.40$**	$r = -0.32$**	-				
5.	Maternal Daytime Dysfunction	$r = 0.40$**	$r = 0.58$**	$r = -0.34$**	$r = 0.45$**	-			
6.	Maternal Total Sleep Quality	$r = 0.49$,**	$r = 0.58$**	$r = -0.70$**	$r = 0.67$**	$r = 0.62$**	-		
7.	Positive Parenting	$r = -0.04$, $p = 0.77$	$r = -0.00$, $p = 0.97$	$r = -0.16$, p = 0.19	$r = 0.09$, $p = 0.46$	$r = 0.06$, $p = 0.62$	$r = 0.10$, $p = 0.43$	-	
8.	Negative Parenting	$r = -0.12$, $p = 0.31$	$r = -0.06$, $p = 0.62$	$r = 0.11$, $p = 0.36$	$r = -0.08$, $p = 0.52$	$r = 0.05$, $p = 0.67$	$r = -0.13$, $p = 0.29$	$r = -0.53$**	-
9.	Infant Negativity	$r = -0.22$, $p = 0.06$	$r = -0.09$, $p = 0.44$	$r = 0.06$, $p = 0.62$	$r = 0.02$, $p = 0.89$	$r = -0.06$, $p = 0.61$	$r = -0.13$, $p = 0.30$	$r = -0.04$, $p = 0.71$	$r = 0.25$*

Note. ** $p < 0.01$, * $p < 0.05$.

Table 6. Bivariate Correlations Between Outcome Variables at 6-Months Postpartum

		1	2	3	4	5	6	7	8
1.	Maternal Anxiety	-							
2.	Maternal Depression	$r = 0.74$**	-						
3.	Maternal Sleep Duration	$r = -0.15$ $p = 0.19$	$r = -0.08$, $p = 0.50$	-					
4.	Maternal Subjective Sleep Quality	$r = 0.35$**	$r = 0.35$**	$r = -0.47$**	-				
5.	Maternal Daytime Dysfunction	$r = 0.33$**	$r = 0.41$**	$r = -0.22$*	$r = 0.49$**	-			
6.	Maternal Total Sleep Quality	$r = 0.34$**	$r = 0.42$**	$r = -0.56$**	$r = 0.74$**	$r = 0.69$**	-		
7.	Positive Parenting	$r = -0.07$ $p = 0.54$	$r = -0.00$, $p = 0.99$	$r = 0.22$, p = 0.07	$r = -0.04$, $p = 0.74$	$r = 0.12$, $p = 0.32$	$r = -0.02$, $p = 0.87$	-	
8.	Negative Parenting	$r = 0.03$, $p = 0.80$	$r = -0.10$, $p = 0.42$	$r = -0.15$, $p = 0.21$	$r = 0.03$, $p = 0.83$	$r = -0.11$, $p = 0.37$	$r = -0.07$, $p = 0.56$	$r = -0.63$**	-
9.	Infant Negativity	$r = 0.03$, $p = 0.81$	$r = -0.01$, $p = 0.94$	$r = -0.25$*	$r = 0.04$, $p = 0.72$	$r = -0.08$, $p = 0.53$	$r = -0.07$, $p = 0.56$	$r = -0.32$**	$r = 0.29$*

Note. ** $p < 0.01$, * $p < 0.05$.

Table 7. Bivariate Correlations Between Outcome Variables at 12-Months Postpartum

		1	2	3	4	5	6	7	8
1.	Maternal Anxiety	-							
2.	Maternal Depression	$r = 0.77$**	-						
3.	Maternal Sleep Duration	$r = -0.23$, $p = 0.08$	$r = -0.17$, $p = 0.21$	-					
4.	Maternal Subjective Sleep Quality	$r = 0.39$**	$r = 0.44$**	$r = -0.57$**	-				
5.	Maternal Daytime Dysfunction	$r = 0.38$**	$r = 0.34$**	$r = -0.25$, $p = 0.06$	$r = 0.44$**	-			
6.	Maternal Total Sleep Quality	$r = 0.51$**	$r = 0.49$**	$r = -0.73$**	$r = 0.70$**	$r = 0.44$**	-		
7.	Positive Parenting	$r = 0.02$, $p = 0.90$	$r = -0.02$, $p = 0.91$	$r = -0.02$, $p = 0.88$	$r = 0.01$, $p = 0.93$	$r = 0.10$, $p = 0.46$	$r = 0.12$, $p = 0.37$	-	
8.	Negative Parenting	$r = -0.00$, $p = 0.99$	$r = 0.05$, $p = 0.75$	$r = -0.15$, $p = 0.27$	$r = 0.24$, $p = 0.09$	$r = 0.06$, $p = 0.66$	$r = 0.01$, $p = 0.96$	$r = -0.50$**	-
9.	Infant Negativity	$r = 0.12$, $p = 0.38$	$r = 0.14$, $p = 0.29$	$r = -0.25$, $p = 0.06$	$r = 0.35$*	$r = -0.10$, $p = 0.48$	$r = 0.12$, $p = 0.37$	$r = -0.18$, $p = 0.18$	$r = 0.46$**

Note. ** $p < 0.01$, * $p < 0.05$.

Table 8. Multivariate Linear Regressions testing associations between indices of maternal sleep at 6-months and positive parenting behaviors at 12-months

Variable	Beta	*t*	*p*
Maternal Education	0.34	2.32	0.03
Subjective Sleep Quality	0.16	1.11	0.28
Maternal Education	0.18	1.25	0.22
Daytime Dysfunction	0.31	2.09	0.04
Maternal Education	0.26	1.77	0.08
Total Sleep Quality	0.21	1.43	0.16

Table 9. Multivariate Linear Regressions testing associations between indices of maternal sleep at 6-months and negative parenting behaviors at 12-months

Variable	Beta	*t*	*p*
Marital Status	-0.28	-2.04	0.05
Infant Negativity	0.42	3.02	0.004
Subjective Sleep Quality	0.14	1.02	0.31
Marital Status	-0.25	-1.84	0.07
Infant Negativity	0.40	2.99	0.005
Daytime Dysfunction	-0.04	-0.31	0.76
Marital Status	-0.26	-1.90	0.06
Infant Negativity	0.40	2.96	0.005
Total Sleep Quality	0.02	0.11	0.91