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DEPARTMENT OF BIOBEHAVIORAL HEALTH

THE ASSOCIATION BETWEEN DEPRESSIVE SYMPTOMS AND MEASUREMENTS OF MOTHERS' QUALITY OF LIFE ONE YEAR POSTPARTUM

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ABSTRACT

The purpose of this study was to examine the relationship between depressive symptoms and other qualities in mothers' lives in the first year after having a child. The qualities in question were positive and negative coparenting, cortisol levels, sleep fragmentation and total sleep time. The present study utilized data collected in Project SIESTA II, being conducted by Dr. Douglas Teti at Penn State University. One hundred and sixty-seven mothers and their babies were recruited for this study. At milestones of months 1, 3, 6, 9 and 12, measurements were taken and mothers filled out questionnaires that were then the basis of the data for the project. Major findings of this study included the decline of depressive symptoms and sleep fragmentation over the 11-month period. Because total sleep time remained stable, we can assume that mothers' sleep becomes more efficient, getting the same amount of sleep with fewer interruptions. Additionally, depressive symptoms were positively correlated with negative coparenting and negatively correlated with positive coparenting. Infant temperament appears to be an important factor not included in these analyses that affects both depression and the quality of coparenting. Future studies should be conducted to further understand the role infant temperament has in the relationship between depression and coparenting.

KEY WORDS

Postpartum, depressive symptoms, coparenting, sleep, cortisol

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Chapter 1

Introduction

The effects of maternal depressive symptoms after giving having a child are important to study due to their prevalence and impact on mothers with the symptoms. Roughly 19.2% of mothers experience depressive symptoms in the first 3 months postpartum (Hübner-Liebermann, et al, 2012). On top of this prevalence, a meager 20-40% of these mothers seek help for their depressive symptoms (Hübner-Liebermann, et al, 2012). According to Kendell, the peak of these postpartum depression symptoms is found 5 days after giving birth (Kendell, et al, 1981). Kendell's study showed that the symptoms then fall slowly after the 5th day, but at 3 weeks postpartum, when the study concluded, the symptoms were still present at some level. Consequently, it is crucial to understand what impacts such depression can have.

Mothers with depressive symptoms have been found to have signs such as decreased verbal communication, problems with sleeping and breastfeeding, and obsessive thoughts (Hübner-Liebermann, et al, 2012). With respect to the babies, Lovejoy reports that the youngest age group of children, infants, is most strongly affected by impaired parenting from depressed mothers (Lovejoy, et al, 2000).

Furthermore, it is important to study mothers with depressive symptoms because their children are also affected. One particular study showed that babies of depressed mothers are most likely to exhibit avoidant attachment (Hübner-Liebermann, et al, 2012).

Therefore, maternal depressive symptoms appear to have implications for both mother and baby.

This study will analyze data collected in Project SIESTA II, a research project conducted at the Pennsylvania State University. Project SIESTA II, which stands for Study of Infants' Emergent Sleep Trajectories, is directed by Dr. Douglas Teti in Penn State's department of Health and Human Development. The project studies the first two years of infants' lives and the contributions from both parents and children to the development of infants' sleep patterns. Project SIESTA II is run by numerous graduate students, post-doctoral fellow Dr. Brian Crosby, and project coordinator Corey Whitesell.

This particular study using Project SIESTA II's data will examine mothers who have data collected for the first year of her infant's life. Specifically, data is collected at milestones of 1, 3, 6, 9 and 12 months. Mothers have been recruited from either Mount Nittany Hospital or Hershey Medical Center.

This study chiefly examines mothers' measurements of cortisol levels, sleep length and fragmentation, and coparenting. Each of these variables will be examined, in comparison with different levels of depressive symptoms. The goal of this study is to determine how these factors and depressive symptoms interact so hopefully, programs can be aimed towards helping these areas in the future.

Previous studies have shown the relationship between depression and the variables of interest. One particular study showed a positive correlation between morning levels of cortisol and the degree of dysphoria in the individual (Hendrick, et al, 1998). However, this study also showed that there was no relationship between total cortisol and postpartum mood, suggesting that neither cortisol, nor one single hormonal process is

likely responsible for these outcomes (Hendrick, et al, 1998). Interestingly, another study suggested that cortisol may actually be indicative of other hormonal changes, and not the root cause of depressive symptoms (Fleming, et al, 1997). Literature appears conflicted within this area of study, which warrants further investigation.

Sleep duration appears to have a U-shaped curve with respect to maternal depression (Kaneita, et al, 2005). This study determined that the highest levels of depression were observed when individuals got less than 6 hours or more than 8 hours of sleep (Kaneita, et al, 2005). Similarly, one symptom of depression is "disturbed sleep" which could suggest anything not "normal" (Winser, et al, 2002). This could be either very high or very low levels of sleep. Additionally, higher amounts of stressful thoughts were associated with more sleep complaints (Hall, et al, 2000). Consequently, it makes sense that these stressed individuals had higher degrees of hyperarousal in non-REM sleep (Hall, et al, 2000).

Coparenting and marital satisfaction are also impacted by depression. Hendrick, et al reported that marital disharmony increases the likelihood of postpartum depression (Hendrick, et al, 1998). Perhaps this relationship is bidirectional and maternal depression can put stress on marital relationships. Additionally, Gotlib and Whiffen report depressed women having issues with affection, sexual functioning and communication (Gotlib and Whiffen, 1989). Such issues would likely have negative impacts on the ability to coparent. Gotlib and Whiffen also say that reported marital satisfaction is usually similar between both parents (Gotlib and Whiffen, 1989). Similarly, assortative mating is often seen in couples, where a depressed individual is more likely to choose a mate who is also

depressed (Burke, 2003). Consequently, if both parents are unhappy, there will likely be poor communication and therefore, poor coparenting.

Uebelacker, et al found that marital dissatisfaction can be precipitated by depression, and depression can also be caused by marital dissatisfaction (Uebelacker, et al, 2003). Additionally, this article suggested that these symptoms could also be caused by a third variable (Uebelacker, et al, 2003). Perhaps this third variable could be the stressor of a new infant in the household reducing the amount of sleep parents are able to get.

This study will compare mothers with depressive symptoms above a cutoff level to mothers below the cutoff level to see how their lives are impacted differently after having a baby. The variables that will be analyzed are cortisol levels, coparenting and sleep length and fragmentation. It is hypothesized that mothers with symptoms of depression will exhibit higher levels of cortisol, less positive coparenting, more negative coparenting, more sleep fragmentation, and either extreme high or low hours of sleep.

Chapter 2

Methods

Participants:

This study uses data collected from Project SIESTA II, which studied 167 infants and parents over the first year of the baby's lives. These families were recruited from Mount Nittany Hospital in State College, PA and Hershey Medical Center in Hershey, PA. A Project SIESTA II staff member recruited mothers from the hospitals between 24-48 hours after giving birth. Families were compensated for their participation.

Attrition analyses were conducted to determine if there were any differences between individuals who dropped out of the study and those who remained in the study for the full 11 months. The tests indicated that neither the demographic variables analyzed (level of education, maternal age, or income), nor the outcome variables of depressive symptoms, positive coparenting, negative coparenting, sleep fragmentation, and cortisol) had an effect on whether or not a mother dropped out of the study. However, sleep time showed significant differences between mothers who dropped out of the study and those who didn't. Mothers who remained in the study tended to get more sleep, on average, than those who dropped out of the study. Please refer to tables 1 and 2 for statistical values from these tests.

Table 1: Attrition analyses for three demographic variables being studied

Variable	Statistics
Level of education	$C^2(2) = .21, p = .9$
Mother's age	$F(1, 164) = .13, p = .72$

Yearly income	F(1, 152) = .56, p = .46

Table 2: Attrition analyses for outcome variables

Variable	Statistics
Depressive symptoms	F(1, 163) = .23, p = .63
Positive coparenting	F(1, 158) = .67, p = .41
Negative coparenting	F(1, 158) = .10, p = .76
Total sleep time	F(1, 154) = 6.13, p = .01
Sleep fragmentation	F(1, 154) = .29, p = .59
Cortisol	F(1, 154) = .28, p = .60

Measurements:

Home visits took place with a SIESTA II staff member and the families at each milestone- months 1, 3, 6, 9 and 12. At these meetings, measurements were taken including demographic information and anthropometric measurements of the baby.

A measure to determine the level of depressive symptoms was also completed by mothers at each time period. The measure was a subscale of the SCL-90-R (Derogatis, 2004). This maternal depression subscale had internal reliability at all age points (alphas = .78 to .92).

The Coparenting Relationship Scale (CRS) (Feinberg, Brown, & Kan, 2012) was completed by mothers and assessed how they perceived their parenting teams, or how they interact with the child's father. Characteristics associated with positive coparenting were agreement, closeness, support, endorsement and division of labor. Indicators of negative coparenting were competition-undermining and exposure to conflict. The measurements of positive coparenting (agreement, closeness, support, endorsement and division of labor) were internally reliable, showing moderate-to-strong intercorrelation at all time periods (Cronbach's alphas = .75, .72, .81, .83, and .79 at 1, 3, 6, 9 and 12

months, respectively). These five measurements of positive coparenting were added at each time period to create a summary positive coparenting variable. Negative coparenting had two measurements (competition-undermining and exposure to conflict) which were also moderately intercorrelated at the five time periods (Pearson *r* values = .31 to .51). Alpha values for negative coparenting (.47, .54, .67, .63, and .54) were lower than the alpha values for positive coparenting. However, this difference can be attributed to the fact that only two measurements were combined for negative coparenting, while five measurements were combined for positive coparenting.

Additionally, for one week at each time period, parents' and babies' sleep was studied. This included wearing an actigraphy watch, which measured movement and consequently, gave an indication of sleep-wake intervals. These watches were worn by baby, mother and father for an entire week. Each day during this week, mothers and fathers had a phone interview to report sleep times, night wakings, and degree of problems associated with infant night wakings. These sleep measurements were meaned to obtain an average sleep measurement for the each time period.

Additional measurements and assessments were also taken at each time period; however, they were not relevant to these particular analyses. For a more complete list of measurements and assessments taken of these families, please consult the original manuscript (Teti, et al, 2012).

Statistics:

Using SPSS statistical software, correlation matrices were created for each time period to examine the relationships between the covariates being studied- depressive symptoms, positive coparenting, negative coparenting, cortisol levels, sleep time, and

sleep fragmentation at each time period. A Spearman's correlation was used because the data is not normally distributed and the sample is not very large. When correlating depression with positive and negative coparenting, sleep time, sleep fragmentation, and cortisol at each time point, Bonferroni's correction was used to reduce risk of type I error within each time point. The usual alpha of 0.05 was divided by the number of tests (5 correlations at each time point), resulting in an alpha of 0.01. Percent variance explained by each variable was estimated by the square of the Spearman's rho (ρ) coefficient.

Repeated measures ANOVA were completed for each of the variables to test for significant changes over time. This was also conducted controlling for maternal education, family income, and mother's age. Additionally, test-retest correlations were completed to test for stability over the time periods (months 1, 3, 6, 9, and 12).

To assess whether a large change in the five variables across the duration of the study was associated with a large change in depression, the initial value (month 1) was subtracted from the final value (month 12) to create a change variable for each measure. Spearman's correlations were then used to determine whether or not there was a significant correlation between the changes in the 5 variables and the change in depression.

Chapter 3

Results

Demographics:

One hundred sixty-seven mothers participated in this study with their infants. However, this particular study focuses on the mothers in the sample. The largest percentage of mothers (38.6%) graduated college with associate's degree, graduated college with bachelor's degree, or attended graduate school but did not graduate. There were equal percentages (30.7% each) of mothers in the two other educational groups. The first group included mothers who attended high school but did not graduate, graduated high school or attended college but did not graduate. The last group included mothers who had a Master's degree, Ph.D, law degree, or medical, dental or other medical degree. The average income of the families in this study is $69,503.59, with the mode being $50,000. The mean maternal age at the start of the study was 29.43 years old, with the mode being 30 years. Additionally, the majority of mothers in this study (95.2%) are living with a partner.

Variables' change over time:

A small percentage of mothers exhibited depressive symptoms above the cutoff. This is the clinical cutoff for the scale being used. There were 16.8% of mothers at month 1, 15% of mothers at month 3, 11.4% of mothers at month 6, 9.6% of mothers at month 9, and 6.6% of mothers at month 12. This decrease in depressive symptoms over the 11-month period was found to be significant $F(4,472) = 8.66$, $p < .01$. Additionally, it was

found that maternal sleep fragmentation also had a significant decline in the first year of the baby's life $F (4, 308) = 29.11$ $p < .001$. These remained constant when controlling for education, age and income. The other variables, positive and negative coparenting, total sleep time, and cortisol levels did not have significant changes over time.

Stability of variables:

Stability over the 11 months was also examined for each variable. Depressive symptoms at 1 month were correlated with depressive symptoms at 12 months $\rho (123) = .41$, $p < .001$. Positive coparenting at 1 month was correlated with positive coparenting at 12 months $\rho (118) = .69$, $p < .001$. Finally, negative coparenting at 1 month also correlated with negative coparenting at 12 months $\rho (118) = .51$, $p < .001$. Consequently, these three variables proved to be stable over the time periods. However, sleep fragmentation $\rho (118) = .27$, $p < .01$, and total sleep time $\rho (118) = .28$, $p < .01$, showed weak correlation across the duration of the study and cortisol levels did not show significant stability across this interval, ($p > 0.05$).

Correlation of depressive symptoms and other variables:

Correlation of depression with each of the other five variables was assessed at each time period (Table 3). Using a Bonferroni's corrected alpha level of .01 (.05/5), it was found that there was a significant negative correlation between maternal depressive symptoms and positive coparenting at months 1, 3, 6, 9, and 12. There was also a significant positive correlation between maternal depressive symptoms and negative coparenting at months 3, 6, 9, and 12. For both of these coparenting variables, 5-20% of variance in depressive symptoms associated with coparenting throughout the interval (see Table 3). Correlations with depression and the remaining variables were not significant.

Because sleep time and sleep fragmentation are believed to have a U-shaped relationship with depression, additional tests were run to test for these associations, but these also were not significant.

Change in depressive symptoms correlated with change in other variables:

The changes observed in each of the same five variables over the 11-month period were calculated as a difference score for each variable. The correlation between these changes with the change in depressive symptoms over the same interval was then tested. Consistent with the associations at each time point, change in depression was only associated with change in coparenting. It was found that change in depression and change in negative coparenting were correlated over the 11 month period $\rho(116) = .25$, $p < .01$. Additionally, the change in depression and change in positive coparenting were marginally correlated over the 11-month period $\rho(116) = -.21$, $p < .05$.

Table 3: Significant association between coparenting and depressive symptoms. * $p \leq 0.01$, ** $p \leq 0.001$ (Associations of depressive symptoms with sleep time, sleep fragmentation, and cortisol were not significant and are not shown.)

	Correlation of Positive Coparenting with Depressive Symptoms	Correlation of Negative Coparenting with Depressive Symptoms
Month 1	$\rho = -.23$, df = 156, $p < .01$*	$\rho = .41$, df = 156, $p = .051$
Month 3	$\rho = -.27$, df = 146, $p \leq .001$*	$\rho = .28$, df = 146, $p \leq .001$*
Month 6	$\rho = -.48$, df = 143, $p < .001$**	$\rho = .47$, df = 143, $p < .001$**
Month 9	$\rho = -.44$, df = 133, $p < .001$**	$\rho = .37$, df = 135, $p < .001$**
Month 12	$\rho = -.25$, df = 119, $p < .01$*	$\rho = .34$, df = 119, $p < .001$**

Chapter 4

Discussion

The present study compared mothers above the depression cutoff to those below the cutoff in how they differed in coparenting, cortisol levels and sleep quality. It was determined that there was a significant decline in maternal depressive symptoms over the first 11 months of the baby's life. Additionally, sleep fragmentation also decreased over the same period of time. However, measurements of positive and negative coparenting, cortisol levels and total sleep time did not decline over the 11 months. Positive coparenting was very stable and negative coparenting was relatively stable across the time periods.

As hypothesized and other literature suggested (Gotlib and Whiffen, 1989), depressive symptoms were found to be negatively correlated with positive coparenting at all time periods. Additionally, depressive symptoms were positively correlated with negative coparenting at all time periods. Similarly, the changes observed in negative coparenting across the eleven months were strongly correlated with the changes observed in depressive symptoms. Changes in positive coparenting were marginally correlated with depressive symptoms. However, contrary to the hypothesis, there were not significant correlations between depressive symptoms and cortisol, sleep fragmentation or total sleep time.

Cortisol:

While cortisol was not significantly correlated with depressive symptoms as hypothesized and other literature suggested, there are several explanations for this lack of association (Hendrick, et al, 1998). For one thing, the measurements for each time period were taken over the course of one day. The mothers could have had a particularly stressful or relaxing day when the samples were taken. This could consequently provide an inaccurate representation of cortisol levels for the entire time period in question.

Similarly, not all individuals' cortisol secretions change the same way during stress. There can be a great deal of variation among both baseline cortisol levels and the amount secreted when faced with stressful situations (Kirschbaum and Hellhammer, 1993). Because only mothers were being studied, sex differences would not play a role in these variations. However, these differences could be attributed to genetics and smoking (Kirschbaum and Hellhammer, 1993). Therefore, a linear association may not be seen between depressive symptoms cortisol levels due to the high variability of cortisol secretions among individuals.

Not only do baseline levels and changes in cortisol vary from person to person, but the direction of change can also vary. One study found a positive association between morning cortisol levels and degree of dysphoria (Hendrick, et al, 1998). However, a study done by Hinkelmann and colleagues found lower levels of cortisol in depressed patients compared to healthy patients (Hinkelmann, et al, 2009). Perhaps individuals react differently to the stress of depression with some having higher cortisol levels and others having lower cortisol levels. This could explain the lack of association between the cortisol measurements and depressive symptoms in the present study.

Additionally, cortisol samples were taken by the participants themselves. Therefore, the accuracy of the cortisol measurements relies on the participants taking the samples correctly. Mothers were supposed to take the samples at four specific times throughout the day. Taking the samples at a time slightly different from what was instructed could introduce inaccuracy to the data and alter the results. Specifically, having a child can make the home life more chaotic and affect whether or not the mother is able to take the cortisol samples at the exact specified times. However, home tests for cortisol do appear to be easy and reliable, as they do not add stress to participants' lives by making them visit a lab.

Coparenting:

While it was determined that both positive and negative coparenting were correlated with depression, the direction of the relationship is not clear. A variable not considered in the present analyses is infant temperament as a moderator of coparenting (Davis, et al, 2009). Davis and colleagues found that supportive coparenting early on was correlated with less infant difficulty (Davis, et al, 2009). Additionally, they believed this relationship between infant temperament and coparenting is bidirectional (Davis, et al, 2009). Feinberg also suggested that infant temperament could affect the quality of coparenting; a more difficult infant would create more stress for parents, cause them to blame each other and not get along as well as they would with an easy child (Feinberg, 2002). Therefore, infant temperament could be playing a role in the development of the quality of coparenting that was not measured in the present study. Perhaps if infant temperament were included, some of the non-significant findings could be explained.

Not only does infant temperament appear to be related to the quality of coparenting, but it could also be affecting the observed maternal depressive symptoms. A study conducted by Cutrona and Troutman found a strong relationship between a difficult infant temperament and mothers' postpartum depression (Cutrona and Troutman, 1986). Infant cries naturally evoke a negative feeling in adults (Frodi, et al, 1987). Therefore, the constant presence of such a stressor could result in some degree of depressive symptoms. It appears that infant temperament affects both coparenting and depression, and is therefore an important variable missing from the present analysis. This kind of data was collected in Project SIESTA II and should be used in future studies.

Another variable that could have affected results but was not considered in the present study is the presence of another child in the family. If the baby in the study is one of 5 children, the mother would likely have very different sleep patterns, relationship with a spouse, and different cortisol levels than a mother of one child. Therefore, future studies should control for the presence of other children in the family to get a more accurate representation of other variables being studied.

Sleep:

Montgomery-Downs and colleagues conducted a study with postpartum sleep measurements similar to the current study. Like the data in the present study was collected, Montgomery-Downs and colleagues measured sleep fragmentation and total sleep times through the use of a wrist actigraphy watch. The results in this study supported the finding that the amount of sleep fragmentation, but not total sleep time, declined in the first year postpartum. Specifically, this study saw the decline in sleep fragmentation between weeks two and sixteen postpartum (Montgomery-Downs, et al,

2011). Additionally, total sleep time also remained constant as it did in the present study (Montgomery-Downs, et al, 2011). As pointed out by Montgomery-Downs, this means that mothers are in bed for a shorter period of time, as they are able to get the same amount of sleep with fewer night-wakings (Montgomery-Downs, et al, 2011). This pattern has also been observed in other studies, including one done by Dorheim and colleagues. Therefore, it is reasonable to conclude that mothers' sleep efficacy improves within the first year postpartum.

Depressive symptoms and coparenting:

Numerous articles suggest that maternal depression and the quality of coparenting would be correlated. Shapiro and colleagues found that mothers reported higher marital satisfaction when their husbands were supportive (Shapiro, et al, 2000). Interestingly, Shapiro, et al also observed that a sense of unity, or "we-ness" was important for mothers to have higher marital satisfaction (Shapiro, et al, 2000). This "we-ness," or unity, is describes a collaborative quality that would be important for positive coparenting. If this is lacking, it is logical that mothers would be generally unhappy and report more depressive symptoms. Shapiro, et al also described negativity and criticism as "corrosive factors" that decrease the marriage quality (Shapiro, et al, 2000). Therefore, these negative feelings, similar to depression, are likely to contribute to an inability for a couple to get along and consequently, coparent.

Belsky and Hsieh conducted a study examining the maternal changes during early childhood and found results similar to those in the present study. Their paper reported stability in marital conflict over the 50 months being studied. Most maternal conflict either "stayed good" or "stayed bad" with a smaller portion going from "good to worse"

(Belsky and Hsieh, 1998). This conflict in a marriage would likely result in ineffective coparenting due to the lack of ability to get along. Thus, Belsky and Hsieh's results provide support for the relatively strong stability of coparenting observed in these analyses. If the quality of coparenting starts as being negative, it will likely continue that way throughout the child's early life.

Additionally, Belsky and Hsieh found that when spouses undermined and did not support each other in parenting goals, there was more conflict and a fewer feelings of love in the marriage (Belsky and Hsieh, 1998). Such conflict and lack of love could easily be a source of depression in parents. Consequently, this provides further support for the connection between depressive symptoms in mothers and negative coparenting caused by undermining and lack of support. As mentioned earlier, it is still likely that this association between coparenting and depressive symptoms is bidirectional. Negative feelings and depression directed toward a spouse would likely increase conflict and undermining (Belsky and Hsieh, 1998).

An interesting study done by Feinberg and Kan compared a control group of families to a group who participated in a Family Foundations (FF) intervention. This intervention is for couples expecting their first child and is designed to improve the couples' quality of coparenting (Feinberg and Kan, 2008). The results of this study showed that the quality of coparenting did, in fact, improve in the intervention group as compared to the control group (Feinberg and Kan, 2008). Not only did coparenting improve as a result of the intervention, but depressive symptoms also decreased in the intervention group more than they did in the control group (Feinberg and Kan, 2008). While these results provided support for the Family Foundations intervention, they also

support the idea that coparenting and depression are somehow related. If one changes, the other appears to, also.

Conclusion:

In summary, it appears that maternal depressive symptoms one year postpartum are linked to both positive and negative coparenting measurements. However, the direction of this relationship is not clear. It is likely that supportive qualities in a couple help establish solid parenting teams, and also protect against depressive symptoms. Additionally, the absence of depressive symptoms may allow for supportive, united parenting, while the presence of depressive symptoms could lead to undermining and disharmony in a marriage.

On the other hand, depressive symptoms do not seem to be consistently associated with cortisol levels, sleep time or sleep fragmentation over the first year. Additionally, it is interesting to note that throughout this time, mothers' sleep appears to become more efficient, with mothers getting same total amount of sleep, but with fewer night-wakings. Future studies should take into account the third variable of infant temperament and study how this affects the other variables of depressive symptoms, positive and negative coparenting. Understanding how all of these variables interact could provide the basis for future interventions to improve both infants' and mothers' qualities of life.

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