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The effect of preterm birth on infant negative affect and maternal postpartum depressive symptoms: A preliminary examination in an underrepresented minority sample

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Abstract

Objective—To examine the effect of preterm birth on maternal postpartum depressive symptoms and infant negative affect in an underrepresented minority sample.

Method—Participants were 102 mothers and their 3- to 10-month-old infants. Mothers completed the Edinburgh Postnatal Depression Scale and the Infant Behavior Questionnaire-Revised.

Results—Relative to normative samples, the current underrepresented minority sample of mostly Hispanics and Blacks displayed high rates of preterm birth (30%) and maternal postpartum depressive symptoms (17%). Preterm birth had a significant direct effect on postpartum depressive symptoms and infant negative affect. Additionally, there was an indirect effect of postpartum depressive symptoms on the relation between preterm birth and infant negative affect. Specifically, lower birth weight and gestational age predicted higher levels of depressive symptoms in the mother, and higher levels of depressive symptoms in the mother, in turn, predicted higher levels of infant negative affect.

Conclusion—Findings emphasize the importance of screening for postpartum depressive symptoms and infant negative affect among mothers and their preterm infants, especially among families from underrepresented minority backgrounds.

Keywords

Preterm birth; Infant negative affect; Postpartum depression; Minority

In the United States, rates of preterm birth (i.e., <37 weeks gestational age) range from 9 to 13% (Hamilton, Martin, Ostermna, & Curtin, 2014) and have increased about 30% in the last 20 years (Raju, Higgins, Stark, & Leveno, 2006). In addition to the negative medical and health complications in infants (Moster, Lie, & Markestad, 2008), preterm birth has been associated with negative consequences in parents, such as maternal depressive symptoms (Miles, Holditch-Davis, Schwartz, & Scher, 2007), and increased risks in the child, such as a difficult infant temperament (Case-Smith, Butcher, & Reed, 1998; Hughes, Shults, McGrath, & Medoff-Cooper, 2002), as well as cognitive deficits and increased behavioral problems (Caravale, Tozzi, Albino, & Vicari, 2005). Despite evidence that prevalence rates of preterm birth are significantly higher among families from economically disadvantaged and

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underrepresented minority backgrounds (Smith, Draper, Manktelow, Dorling, & Field, 2007) ranging from 10% in Hispanics to 17% in Blacks (Hamilton et al., 2014), research on the relation between preterm birth and negative parent and child outcomes has largely relied on predominately white, middle class samples (McGrath, Records, & Rice, 2008). Therefore, a primary goal of this study was to explore the relation between preterm birth, postpartum depressive symptoms, and difficult infant temperament in families from underrepresented minority backgrounds.

Research has demonstrated significantly higher levels of maternal depressive symptoms within the first year after child-birth among mothers of children born preterm compared to mothers of children born full-term (Voegtline & Stifter, 2010). Previous research has demonstrated higher rates of postpartum depressive symptoms among underrepresented minority mothers, ranging from 11 to 12% in Hispanics and Blacks compared to 7% in Whites (Liu & Tronick, 2013). Considering the elevated rates of postpartum depressive symptoms among mothers from underrepresented minority ethnic and racial backgrounds, research is needed to examine the relation between preterm birth and postpartum depression beyond the predominately white, middle class samples. However, in a recent review examining the association between preterm birth and maternal depressive symptoms, only one of 26 studies included an ethnically and racially diverse sample (Vigod, Villegas, Dennis, & Ross, 2010). Acknowledging the limited research examining the relation between preterm birth and postpartum depressive symptoms in mothers from underrepresented minority backgrounds, and the considerably higher rates in this population (Howell, Mora, Horowitz, & Leventhal, 2005), it is important to examine the relation between these variables among families from underrepresented minority backgrounds.

In exploring predictors of postpartum depressive symptoms among mothers with premature infants, most research has focused on other maternal variables. For example, high levels of stressful life events, as well as low levels of social support and maternal education, have been found to be associated with postpartum depressive symptoms in mothers with preterm infants (Poehlmann & Fiese, 2001). These studies, however, did not take into account child variables that are also related to levels of postpartum depressive symptoms. For example, poor infant engagement and orientation has been shown to negatively affect the way in which a mother feels about her infant (Beebe et al., 2012), and therefore may be an important variable to consider. Infants born premature are more likely than full-term infants to have a difficult temperament, including higher levels of negative arousal (Klein, Gaspardo, Martinez, Grunau, & Linhares, 2009) and negative affect (Hughes et al., 2002), and display less adaptability and more distractibility (Hughes et al., 2002). Research has largely relied on maternal report of infant temperament, and has found that in comparison to mothers of full-term infants, mothers of preterm infants reported their infant to have a more difficult temperament (Denis, Ponsin, & Callahan, 2012). However, similar to the literature on the relation between preterm birth and postpartum depressive symptoms, most studies examining the relation between preterm birth and infant negative affect (e.g., infant temperament) have been limited to predominately white, middle class samples.

In addition to the relation between preterm birth and negative affect, numerous studies have demonstrated an association between infant negative affect and maternal depressive

symptoms. For example, maternal-reported and observed difficult infant temperament predicted maternal postpartum depressive symptoms (Britton, 2011). Additionally, mothers who reported a difficult temperament, specifically fussiness and irritability, in their infant were more likely to report higher levels of depressive symptoms within the first year after birth (McGrath et al., 2008). Given the significant impact of depression during the postpartum year on later child outcomes (Bagner, Pettit, Lewinsohn, & Seeley, 2010), research is needed to explore potential mechanisms by which preterm birth is associated with postpartum depressive symptoms and infant negative affect, especially with high-risk samples.

To our knowledge, only one study examined a model including premature birth, postpartum depressive symptoms, and infant negative affect. Specifically, Voegtline and Stifter (2010) found preterm birth predicted higher levels of maternal depressive and anxiety symptoms, which in turn predicted higher levels of infant negative affect. However, similar to the other studies on the relation between preterm birth and maternal depressive symptoms and difficult infant temperament, Voegtline and Stifter (2010) included a predominantly white sample. Therefore, it is important to understand whether or not these variables relate to one another in the same way among families from underrepresented minority backgrounds.

Given the reliance on predominantly white, middle class samples, the first goal of the present study was to examine the association between preterm birth and postpartum depressive symptoms and infant negative affect in an underrepresented minority and economically disadvantaged sample. Based on the previous literature, we hypothesized that preterm birth would be associated with higher levels of maternal depressive symptoms and infant negative affect. The second goal of the study was to replicate findings of the indirect effect of maternal depressive symptoms on the relation between preterm birth and infant negative affect (Voegtline & Stifter, 2010) in an underrepresented minority sample. We expected preterm birth to be associated with higher levels of maternal depressive symptoms, which in turn would predict higher levels of infant negative affect.

1. Methods

1.1. Participants and procedures

The current study is a secondary data analysis of a larger study on postpartum depression that took place at a large hospital-based pediatric primary care clinic, from 2011 to 2013, serving mostly families without private insurance. The inclusion criteria for the larger study were the following: mothers had to be at least 18 years old, not be receiving treatment for depression at the time of the screening, and have an infant 10 months old or younger. Research assistants approached 458 mothers during their infant's well or sick visit to describe the study, and 284 mothers (62%) expressed interest and provided written consent to participate. The most common reasons that mothers declined participation were that they were not interested or did not have enough time at the pediatric visit. Only one mother reported being less than 18 years old, and no mothers reported that they were receiving treatment for depression at the time of the screening. All 284 participating mothers completed a demographic questionnaire, which included questions about the infant's gestational age and birth weight, as well as the mother and infant's race and ethnicity. This

study was approved by the Institutional Review Boards at both the children's hospital and affiliated university of the authors.

In this secondary data analysis, we excluded 119 (42%) of the 284 participating mothers who had an infant younger than 3 months, because the *Infant Behavior Questionnaire-Revised (IBQ-R)* has not been validated in children younger than 3 months (Gartstein & Rothbart, 2003). Due to a change in the protocol for the larger study, the IBQ-R was initially not administered at the time of the screening and as a result we excluded an additional 62 (22%) mothers with an infant between the ages of 3 and 10 months who had not completed the IBQ-R. Furthermore, we excluded one mother because she was the only participating mother in this subgroup reporting non-minority (i.e., white) status, and we wanted to examine the aforementioned hypotheses within families from underrepresented minority backgrounds. However, all results reported below were comparable when including this mother. The final sample included in this study was 102 mothers and their infant. Mothers were on average 27.60 years ($SD = 5.81$ years; range = 18–42 years), and their infants (52.9% male) were on average 6.31 months ($SD = 2.20$; range = 3–10 months). With regard to minority status, 85.3% were Hispanic, 13.7% were black, and 1% was American Indian. Close to half of the mothers (44.2%) reported only completing high school. Of those mothers reporting income, 54% were below the poverty line based on the U.S. Department of Health and Human Services guidelines for 2014 (Services, 2014). See Table 1 for a summary of participant demographic characteristics, including characteristics by gestational age and birth weight.

1.2. Measures

1.2.1. Preterm birth—Preterm birth was assessed using parent-report of gestational age and birth weight as a latent construct. Consistent with previous research, the use of both measures in analyses is recommended to increase reliability when studying preterm birth (Slaughter, Herring, & Thorp, 2009).

1.2.2. Minority status—Minority status was assessed using parent report of race and ethnicity in accordance with the race/ethnicity categories used by the U.S. Census Bureau.

1.2.3. Postpartum depressive symptoms—The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987), a 10-item self-report questionnaire designed to assess postpartum symptoms within the past 7 days, was used to assess postpartum depressive symptoms. Each of the ten items is scored on a four-point scale (0–3), and total scores range from 0 to 30. The EPDS has been analyzed as a continuous variable to assess depressive symptoms (Ludermir, Lewis, Valongueiro, de Aralijo, & Araya, 2010). Convergent validity has been established via significant associations with a diagnosis of postpartum depression and with other depressive symptom scales. Internal consistency was demonstrated to be strong in the larger predominantly minority sample ($\alpha = .83$; Hartley, Barroso, Rey, Pettit, & Bagner, 2014) and in the current ($\alpha = .85$) sample.

1.2.4. Infant temperament—The Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003), a parent-report questionnaire designed to assess infant

temperament, with each item scored on a seven-point scale from 1 (“never”) to 7 (“always”), was used to assess infant negative affect. High estimates of internal consistency have been reported for each of the 14 subscales (Gartstein & Rothbart, 2003). We included four scales (i.e., Distress to Limitations, Fear, Sadness, and Falling Reactivity/Rate of Recovery from Distress) because they displayed the highest loadings onto a latent construct of negative affectivity (Gartstein & Rothbart, 2003), which is typically used as a measure of difficult infant temperament (Rothbart, Ahadi, & Evans, 2000) and significantly associated with maternal depressive symptoms (Huot, Brennan, Stowe, Plotsky, & Walker, 2004). Internal consistency for each subscale in the current sample was acceptable ($\alpha = .85$ for falling reactivity, $\alpha = .86$ for sadness, $\alpha = .68$ for distress, & $\alpha = .89$ for fear).

1.3. Data analysis

1.3.1. Outliers—Prior to analysis, the data were evaluated for multivariate outliers. Both model-based and non-model based outlier analyses were pursued. For the former, a leverage score was calculated for each individual, and an outlier was defined as anyone having a leverage score four times the value of the mean. Model-based outliers were examined using limited information regression analyses for each of the linear equations dictated by the path models tested. Standardized df beta values for each individual, predictor, and intercept were examined in order to isolate unusually influential individuals in parameter estimation. An outlier was defined as having an absolute standardized df beta larger than 1.0. One outlier was evident using this criterion. Analyses were conducted both with and without the outlier and yielded comparable results. Therefore, all results presented included the outlier.

1.3.2. Missing data—Missing data were minimal, occurring sporadically and never exceeding more than 3% of the cases for all variables included in the models. For the few cases where missing data occurred, values were imputed using the Expectation-Maximization method in SPSS 20.0 and findings were the same with and without the imputed scores. Results presented included the imputed scores.

1.3.3. Normality—The data were examined using univariate indices of skewness and kurtosis. Examination of univariate indices revealed kurtosis values above the absolute value of 1.96 only for one variable in the models: gestational age. The kurtosis absolute value was 6.39 for the gestational age of the child, which was not surprising given most children were born between 37 and 40 weeks gestation. Given the nonnormality at the univariate level, the model was evaluated using bootstrapping with 2000 bootstrap replicates and bias corrected interval estimation as implemented in AMOS 20. As recommended by Bollen and Stine (1992), the p value for the overall fit of the tested models was calculated using the Bollen–Stine bootstrap approach in place of the traditional chi square statistic. All significance tests and confidence intervals reported are from the bootstrap analyses.

1.3.4. Covariates—Infant age in months, infant gender, maternal age, and maternal education were all included as covariates in the models given that they were significantly correlated with infant negative affect and maternal depressive symptoms in the current sample ($p < .05$). When we corrected infant age for prematurity, all results remained the same. Therefore all results reported examined infant age using chronological age.

Acknowledging potential differences among minority groups, race and ethnicity were examined as covariates and results remained the same. Infant gender was dummy coded, 0 for male and 1 for female. Race and ethnicity were combined into one variable, with 1 for Hispanic and 0 for non-Hispanic minority.

In both models, preterm birth was examined as a latent construct with gestational age and birth weight in grams as indicators (Slaughter et al., 2009; loadings of .85 and .74, respectively). Infant negative affect also was examined as a latent construct with four indicators: sadness, distress to limitations, falling reactivity, and fear. Factor loadings for the four temperament subscales were acceptable (.44–.81). The use of a latent variable has been shown to reduce measurement error and help account for unexplained variance (Cheung & Lau, 2008). To ease interpretation, covariates (infant age, infant gender, maternal age, and maternal education) and correlations between exogenous variables were excluded from all figures.

2. Results

2.1. Preliminary analyses

2.1.1. Descriptive analyses—Observed means and standard deviations are presented in Table 1. Thirty percent of infants were born at or less than 37 weeks gestation, and 16% weighed 2500 g or less, which is considered low birth weight (Vigod et al., 2010). Seventeen percent of mothers were above the clinical cutoff for depression on the EPDS (i.e., total score of 13 or higher), placing them at high risk for postpartum depression (Cox et al., 1987).

2.2. Analyses effects

The first model tested a direct effect of preterm birth on maternal postpartum depressive symptoms and infant negative affect. Following recommendations of (Bollen & Long, 1993), a variety of indices of model fit were evaluated and suggested a good model fit (see Table 2).

Results revealed that the latent construct of preterm birth significantly predicted postpartum depressive symptoms, such that mothers with infants born earlier and at a lower birth weight reported higher levels of depressive symptoms. For every one unit decrease in the latent variable of preterm birth, there was a .91 unit increase on the EPDS. Results also revealed that the latent construct of preterm birth significantly predicted infant negative affect, such that mothers with infants born earlier and at a lower birth weight reported higher levels of negative affect in their infant. For every one unit decrease in the latent variable of preterm birth, there was a .15 unit increase in infant negative affect.

The second model (Fig. 1) tested the indirect effect of maternal postpartum depressive symptoms on the relation between preterm birth and infant negative affect. Indices of model fit for the indirect effect of maternal postpartum depressive symptoms on the relation between preterm birth and infant negative affect demonstrated good model fit (see Table 2). In this model, there was a significant direct effect of preterm birth on infant negative affect ($p < .05$). The joint significance test paradigm was used to test the indirect effect hypothesis. The joint significance method for testing indirect effects is recommended over other

methods because it offers low Type I error rates while maximizing statistical power (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). The path from preterm birth to postpartum depressive symptoms and the path from postpartum depressive symptoms to infant negative affect in Fig. 1 were both statistically significant ($p < .01$), suggesting postpartum depressive symptoms partially accounted for the relation between preterm birth and infant negative affect (after controlling for infant age and gender, and maternal age and education). Specifically, lower birth weight and gestational age predicted higher rates of depressive symptoms in the mother ($p = .007$), and higher rates of depressive symptoms in the mother, in turn, predicted higher levels of infant negative affect ($p = .003$). In addition, when examining the bias corrected confidence intervals associated with the indirect effect mentioned above, the confidence interval did not contain zero, providing further evidence for the indirect effect.

3. Discussion

Overall, findings demonstrated that, relative to normative samples (Raju et al., 2006; Vigod et al., 2010), the current sample displayed high rates of preterm birth (30%) and high rates of maternal postpartum depressive symptoms (17%). These rates highlight the high-risk nature of the current sample and the need to assess these problems in underrepresented minority samples. Consistent with our hypothesis and previous research (Vigod et al., 2010; Voegtline & Stifter, 2010), preterm birth predicted higher levels of postpartum depressive symptoms and infant negative affect. Furthermore, this study extended previous findings on the relation between preterm birth and postpartum depressive symptoms and the relation between preterm birth and infant negative affect in a sample of families from underrepresented minority backgrounds.

In addition to the direct effects, we replicated previous research (Voegtline & Stifter, 2010) by demonstrating the indirect effect of postpartum depressive symptoms on the relation between preterm birth and infant temperament. Nevertheless, we acknowledge the inability to determine directionality with a cross-sectional design. Hence, we are not claiming mediation based on the evidence of indirect effects in the current study. Given the promising findings, however, future longitudinal research studies including multiple time points should be conducted examining a mediational model to help elucidate the directionality of effects between postpartum depressive symptoms and infant negative affect.

Considering the limited research of these constructs with underrepresented minority samples, a strength of the current study was the examination of these constructs with only underrepresented minority mothers and their infants. Additionally, the use of structural equation modeling allowed us to examine multiple indicators of latent constructs, thereby reducing measurement error (Cheung & Lau, 2008). Furthermore, the use of multiple indicators allowed us to better conceptualize preterm birth and infant negative affect according to previous research (Slaughter et al., 2009). These findings highlight the importance of further studying the relation between these constructs and developing and testing interventions for high-risk families.

The current study has several limitations that are important to consider. First, the current study was cross-sectional, which as indicated above, did not allow for a formal test of mediation. Relatedly, we were unable to examine the possible transactional relation between maternal postpartum depressive symptoms and difficult infant temperament over time. Second, data on infant negative affect was only collected from the mothers in all cases and we did not collect information from other caregivers. Future studies should examine infant data from other caregivers, such as fathers, because mothers with elevated postpartum depressive symptoms may have a biased perceptions of their infant's negative affect (Noorlander, Bergink, & Van Den Berg, 2008). Nevertheless, the extent to which postpartum depressive symptoms lead to a bias in reporting is still unclear. For example, one study found that while mothers experiencing chronic postpartum depression (i.e., >8 months) were more likely to have negative perceptions of their children's behavior, mothers experiencing brief episodes (i.e., <4 months) of postpartum depression did not have more negative perceptions of their children's behavior (Cornish et al., 2006). Therefore, the bias in maternal report of infant negative affectivity may depend on the severity or timing of the symptoms of postpartum depression. Furthermore, differences have been reported between parent ratings and observations of infant negative affect (Pauli-Pott, Mertesacker, Bade, Bauer, & Beckman, 2000), and therefore future research should investigate potential differences in the findings when including observations of infant negative affect.

Third, we only assessed postpartum depressive symptoms as a measure of parent functioning. It is possible a latent construct including other related measures such as anxiety symptoms or levels of parenting stress would have provided a more comprehensive measurement of parental distress. Similarly, we did not collect information on depressive symptoms in other caregivers (e.g., fathers), which has been shown to significantly affect child outcomes (Paulson & Bazemore, 2010). Fourth, although this was an underrepresented minority sample, a large percentage of the sample reported being Hispanic. Therefore, future research should examine these constructs in more diverse samples, as well as assess the level of acculturation for immigrants.

Fifth, preterm infants are not a homogenous group and thus infant maturity and other associated factors may influence infant negative affect. Examining variability in maturity, neonatal illness severity, and current health status in preterm infants may help clarify some differences in infant temperament and maternal postpartum depressive symptoms in future studies. Lastly, due to the relatively small sample of preterm infants ($n = 31$) in this study, there are limits to generalizability, and results should be interpreted as preliminary. Although we examined preterm birth on a continuous scale, it should be noted that late preterm births (80% of our sample of infants born preterm) account for approximately 84% of preterm births (Blencowe et al., 2012) and have been associated with poor child outcomes (Boyle et al., 2012; Quigley et al., 2012). Nevertheless, future studies should examine the effect of preterm birth on maternal postpartum depressive symptoms and infant negative affect in a larger sample including a representation of early, moderate, and late preterm infants.

Despite these limitations, the present study provided preliminary support for the relation between preterm birth and maternal depressive symptoms and infant negative affect in an underrepresented minority sample. Given the findings that preterm birth is associated with

high levels of maternal postpartum depressive symptoms and of infant negative affect, there are significant clinical implications. Specifically, screening for postpartum depression and infant negative affect among families of preterm infants, particularly those from underrepresented minority backgrounds, could help identify mothers and infants in need of and who may benefit from intervention. Continued research on these constructs and future findings could significantly impact the development of novel interventions, such as targeting depressive symptoms, among mothers of infants born preterm. Early intervention for these problems is crucial considering the long term negative outcomes of postpartum depressive symptoms and infant negative affect during the first year of the child's life (Bagner et al., 2010).

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Fig. 1.

Path model for effects of postpartum depressive symptoms on the relation between preterm birth and negative affect.

Table 1

Demographic characteristics.

Characteristic	Full sample (N = 102)			Gestational age (n = 31)			37 weeks (n = 16)			2500 g (n = 16)		
	M	SD	N (%)	M	SD	N (%)	M	SD	N (%)	M	SD	N (%)
Infant age (months)	6.31	2.19		6.67	2.12		6.81	2.07				
Infant gestation (weeks)	37.95	2.61		34.99	2.67		34.04	3.22				
Infant birth weight (g)	3149.07	687.93		2576.08	744.70		1996.51	497.02				
Infant gender (% male)			54 (52.9)			18 (58.1)						10 (62.5)
Mother education (% only high school)			26 (44.2)			9 (29.0)						5 (31.3)
Mother age (years)	27.60	5.81		26.00	5.54		24.56	4.27				
Edinburgh Postnatal Depression Scale	7.61	5.38		10.81	5.99		10.69	4.87				

Table 2

Model fit indices.

Fit indices	Direct effect model	Indirect effect (Fig. 1)
Bollen–Stine χ^2	$p = .19$	$p = .66$
RMSEA	.06	<.001
PCLOSE	.40	.88
CFI	.96	1.00
SRMR	.06	.05

Note. Bollen–Stine χ^2 = Bollen–Stine bootstrapped chi-square; RMSEA = root mean square error of approximation; PCLOSE = p value for test of close fit; CFI = comparative fit index; SRMR = standardized root mean square residual.