

Maternal Depressive Symptoms and Toddler Outcomes in Children Born Preterm

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Background

The rate of preterm birth increased by 14% during the past decade, resulting in more than 500,000 infants born preterm in the United States each year (March of Dimes, 2006). Mothers of infants born preterm or low birthweight (PT/LBW) are at risk for experiencing psychological distress and depression particularly in the months immediately following the child's birth. Although these symptoms often subside by the end of the child's first or second year of life, it is important to examine the implications of maternal depression trajectories for the development of preterm infants.

Behavioral self-regulation typically occurs about 2 years of age and is characterized by compliance, the emerging ability to delay upon request, and engaging in behavior consistent with parental expectations in the absence of external control or monitoring, although with limited flexibility (Kopp, 1982). An example of self-regulation within the context of the parent-child relationship is compliance to requests, whereas regulation that occurs outside the context of the parent-child relationship is often referred to as "effortful control," or the child's ability to suppress a dominant response and show a subdominant response. Although a growing body of research has examined antecedents of emerging self-regulation in samples of full-term healthy children, few studies have examined developing self-regulation in PT/LBW infants.

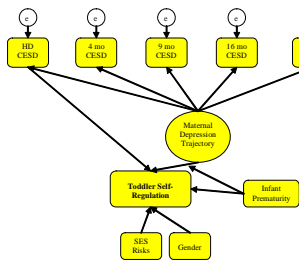
Thus, the goal of the present study was to examine trajectories of maternal depressive symptoms over time in relation to emerging self-regulation and cognitive skills in toddlers born PT/LBW.

Hypotheses

Hypothesis 1: Children of mothers who did not show a decreasing pattern of depressive symptoms over time would have less optimal 24-month cognitive and behavioral outcomes.

Hypothesis 2: Infants born more premature whose mothers' depressive symptoms increased over time would have the least optimal cognitive and behavioral outcomes at 24 months postterm when compared to infants born heavier or closer to term and to infants of mothers whose depressive symptoms decreased over time.

Figure 1: Conceptual Model



Methods

The study had a prospective longitudinal design. A total of 181 infants and their mothers were enrolled in the study, and 153 dyads continued to participate in the study at 24 months postterm. Dyads were assessed at 5 time points: just prior to the infant's NICU discharge and again at 4, 9, 16, and 24 months corrected age. Infant prematurity data were collected through infant medical records. Sociodemographic characteristics were collected at hospital discharge. Maternal verbal abilities were assessed at 16 months with the Peabody Picture Vocabulary Test, 3rd edition (PPVT-III). Toddler behavior problems were assessed at 24 months postterm with the Child Behavior Checklist (CBCL). Maternal depressive symptoms were assessed at each time point with the CES-D questionnaire. At 24 months, children's cognitive skills were assessed with the Stanford-Binet 5th edition routing subscales and effortful control was measured using a behavioral multitask battery in a laboratory setting. Compliance was assessed with a mother-toddler clean up task at 24 months that was videotaped and coded.

Sample

A total of 181 mothers and their infants were recruited from three NICU's in Wisconsin. Infant birthweights ranged from 23 to 37 weeks, with a mean of 31.4 weeks (SD = 3.15), and infants spent an average of 33 days (SD = 28.01) in the NICU. Thirty-four (19%) were part of a multiple birth. At hospital discharge, mothers were an average of 29 years old (SD = 6.24) and had completed 14 years of education (SD = 2.70), and 175 mothers (70%) reported they were married. The average household income at hospital discharge was \$59,995 (SD = \$53,563), with 40 (22%) families below the federal poverty level. 120 (66%) infants were European American, 30 (17%) infants were biracial or multiracial, 25 (14%) infants were African American, 3 (1.5%) infants were Latino, 2 (1%) infants were Middle Eastern, and 1 (.5%) infant was Japanese. 95 (53%) infants were boys and 86 (48%) infants were girls.

Table 1: NICU discharge sample descriptive statistics (n=181).

Variable	Range or Frequency	Mean or %	SD
Infant			
Birthweight	49g – 332g	1739 g	589
Gestational Age	23 – 37 weeks	31.4 weeks	3.15
Gender (female)	77	50%	
Mother			
Age	17 – 42 years	29 years	6.24
Education	8 – 21 years	14 years	2.70
Marital Status (married)	125	70%	
Household Income	0 - \$500,000	\$59,995	\$53,563

Measures

Infant Prematurity: Infant birthweight and gestational age were standardized and summed to create an index of infant prematurity. The infant prematurity index ranged from -4.39 to 3.90 (Mean = -12, SD = 1.98), with higher scores representing less prematurity.

Family Sociodemographic Risks: Demographic questionnaires were completed by mothers before hospital discharge. One point was given for each of the following: family's income falls below the federal poverty guidelines adjusted for family size, unemployment of both parents, single mother, teenage birth, 4 or more dependent children in the home, less than a high school education for the mother, and less than a high school education for the father. Scores could range from 0 to 7, with higher scores representing more risks (alpha = .75).

Maternal Depression: The Center for Epidemiologic Studies-Depression Scale (CES-D) was used to assess maternal depressive symptoms at each time point. Mothers were asked to self-report on a 20 item questionnaire, rating their symptoms on a 4-point scale. Scores of 16 and above are considered in the clinical range. Alpha's for the study were .87, .85, .88, .87, and .89 for the NICU discharge, 4 month, 9 month, 16 month and 24 month time points.

Toddler Behavior Problems: The problem list of the preschool form of the Child Behavior Checklist (CBCL) was used to assess children's behavior at 24 months postterm. Mothers rated 99 problem behaviors on a 3-point scale in regard to the child's behavior that was observed during the past two months.

Toddler Cognitive Development: The routing subscales of the Stanford-Binet 5th Edition were used to assess toddler cognitive development at 24 months. Using the nonverbal and verbal routing tests, an abbreviated IQ was calculated. Scores for the sample ranged from 52 to 121 (M = 80.29, SD = 18.72).

Toddler Effortful Control: Effortful control was examined using a multitask battery (Kochanska, Murray, & Harlan, 2000). Three components of effortful control were assessed: ability to delay (Snack Delay), suppressing-initiating activity to signal (tower), and effortful attention (Animal Shapes). Tasks were videotaped and coded, with high inter-rater reliability.

Toddler Compliance: The child's ability to comply with the mother's requests was assessed through a toy pickup task that followed an unstructured 15 minute play session. We used a continuous approach to coding, using 30 second intervals using mutually exclusive codes: (1) committed compliance, (2) situational compliance, (3) passive noncompliance, (4) refusal negotiation, and (5) defiance. Interrater reliability was high.

Maternal Language Skills: The Peabody Vocabulary Test, 3rd Edition (PPVT-III) was individually administered to measure maternal receptive one-word vocabulary during the 16 month visit. This was used as a control variable for analyses involving toddler cognitive outcomes.

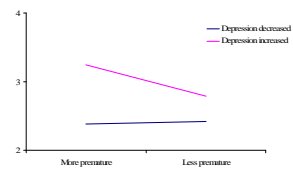
Results

The hypothesized model (Figure 1) was assessed via structural equation modeling (SEM) with Mplus version 5. Two models were completed for each toddler outcome (i.e., toddler compliance, effortful control, internalizing and externalizing behavior problems, and cognitive skills). The first model assessed maternal depression trajectories as a continuum and served as the base model. Within the base model, empirically derived latent classes were generated from maternal depression scores across time resulting in two classes: maternal depression that decreased or remained relatively low over time (n = 133) and maternal depression that remained elevated, increased or was erratic over time (n = 34). Because of the low sample size in the second latent class, we only interpreted the findings from the first latent class.

Compliance:

In the base model, toddler compliance during the clean up task was predicted by infant prematurity ($\beta = -1.06, p < .05$), gender ($\beta = 2.40, p < .01$) and the interaction term of prematurity and maternal depression trajectory ($\beta = -3.51, p < .01$). Infants who were less premature and girls exhibited less defiance and more compliance during the clean up task. Post-hoc analyses of the interaction term (via median split) were consistent with our theoretical hypotheses. Toddlers born earlier to mothers whose depression increased over time exhibited the least compliance and most defiance, followed by toddlers born less premature to mothers whose depression increased over time. The least defiance was shown by toddlers born to mothers whose depression decreased over time, regardless of prematurity status (Figure 2).

Figure 2: Toddler noncompliance interaction for base model.



For the latent class of mothers whose depression decreased or remained relatively low, toddler compliance was predicted by infant gender ($\beta = -2.06, p < .05$) and the interaction term of prematurity and maternal depression trajectory ($\beta = -3.06, p < .01$). Findings were similar to the base model.

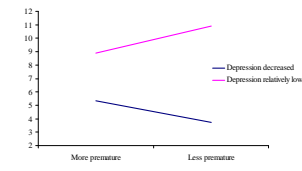
Effortful Control:

Toddler wait times on the delay of gratification task were not predicted by any of the variables included in the base model. Within the latent class model, there was only one significant finding for the delay outcome. In the latent class of mothers whose depression decreased or remained relatively low, toddler wait times were predicted by infant prematurity ($\beta = 2.14, p < .05$). Infants who were less premature had longer wait times.

In the effortful attention base model, toddler effortful attention was predicted by infant prematurity ($\beta = 2.79, p < .01$) and gender ($\beta = 2.44, p < .01$). Infants who were less premature and girls performed better on the effortful attention task. In this model, effortful attention was not predicted by maternal depressive symptoms at NICU discharge, maternal depression trajectories or family SES risks. Within the latent class of mothers whose depression decreased or remained relatively low, effortful attention was predicted by gender ($\beta = 2.12, p < .05$), family SES risks ($\beta = 2.56, p < .01$), and the interaction between infant prematurity and maternal depression trajectories ($\beta = -2.15, p < .05$). Girls and toddlers from families facing fewer SES risks performed better on the effortful attention task. Post-hoc analyses of the interaction term revealed the best effortful attention in infants who were less premature from mothers whose depression remained low over time, followed by infants born more premature from mothers whose depressive symptoms remained low over time (Figure 3). Toddlers born to mothers whose depressive symptoms were initially high and then decreased over time performed more poorly on the effortful attention task, with the poorest performance among infants born less preterm in this group.

In the base model for the suppressing-initiating activity to signal task, toddler turn-taking at 24 months postterm was not predicted by any of the variables specified. In the latent class model, SES risks predicted toddler turn-taking for the latent class group of mothers whose depression decreased or remained relatively low ($\beta = -3.14, p < .01$).

Figure 3: Effortful attention interaction for latent class model.



Behavior Problems:

Maternal reports of toddler externalizing behavior problems at 24 months post term were predicted by maternal depressive symptoms at hospital discharge in the base model ($\beta = 4.67, p < .01$) and in the latent class model for the latent class of mothers whose depression decreased or remained relatively low over time ($\beta = 4.06, p < .01$). Mothers with elevated depressive symptoms at hospital discharge reported more toddler behavior problems than adolescents two years later. Toddler externalizing behavior problems were not predicted by maternal depression trajectories and the controls of infant prematurity, family SES risks, or gender.

In the base model, toddler internalizing behavior problems at 24 months post term were predicted by maternal depression at hospital discharge ($\beta = 2.52, p < .05$). Mothers with elevated depressive symptoms at hospital discharge reported more internalizing behavior problems in their toddler. The controls of infant prematurity, family SES risks, and gender were not significant. In the latent class model the findings were different across classes. Within the latent class of mothers whose depression decreased or remained relatively low, internalizing behavior problems were predicted by maternal depression at hospital discharge ($\beta = 2.74, p < .05$) and gender ($\beta = 2.24, p < .05$), see Table 2. Mothers with elevated depressive symptoms at hospital discharge reported more internalizing behavior problems in their toddler and more internalizing behavior problems in girls. The controls of infant prematurity and SES were not significant.

Table 2: Internalizing behavior problems for latent class two.

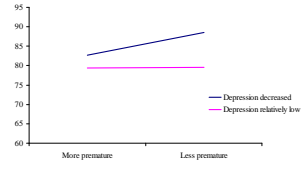
Outcome	Est	SE	TS	P
DI on SES	.78	.54	1.44	.15
DS on SES	.01	.02	.28	.78
DI on DS	-7.59	11.89	-.64	.52
In Probs on DI	.75	.27	2.74	.01
In Probs on DS	.66	3.51	.19	.85
In Probs on Baby Risk	.89	1.82	.49	.62
In Probs on SES	-.19	.82	-.23	.82
In Probs on Gender	3.72	1.66	2.24	.03

Cognitive Development:

The base model for toddler cognitive development did not have an acceptable fit and was therefore not interpreted. The latent class model revealed a substantial AIC decrease and was interpreted. Within the latent class of mothers whose depression decreased or remained relatively low, toddler cognitive development was predicted by family sociodemographic risks and the interaction term between maternal depression trajectories and infant prematurity. Consistent with previous research, toddlers from families facing more SES risks had lower IQ estimates.

Post-hoc analyses of the interaction term using median split revealed higher IQ estimates from infants born less premature from mothers whose depression dropped steeply across time when compared to toddlers born to mothers whose depression remained relatively low or increased slightly but to subclinical levels (see Figure 4). Within this latent class, family SES and maternal vocabulary skills did not predict maternal depressive symptoms at NICU discharge or maternal depression trajectories. As expected, family SES risks were positively correlated with maternal vocabulary skills. Toddler IQ estimates within this class were not predicted by maternal depression at NICU discharge, maternal depression trajectories, maternal language skills, infant prematurity, or gender.

Figure 4: Cognitive development interaction for latent class model.



Summary

Mothers of infants born preterm or low birthweight are at risk for experiencing elevated psychological distress and depressive symptoms following their nonmaternal birth experience. Although these symptoms typically decline over time, some mothers experience chronically elevated or increasing symptoms, which may have negative implications for their children's social and cognitive development, particularly for the most fragile PT/LBW infants. In our prospective longitudinal study of maternal depression and emerging self-regulation in toddlers born preterm or low birthweight, four key findings emerged.

- ◆ When toddlers were born earlier and at lower birthweights to mothers whose depressive symptoms increased over time, they exhibited the most defiance and least compliance during a mother-toddler clean up task, consistent with our multiple risk hypothesis.
- ◆ Mothers who reported more depressive symptoms at hospital discharge had toddlers who exhibited more maternal-reported internalizing and externalizing behavior problems at 24 months postterm.
- ◆ Infants who were more vulnerable at birth (i.e., lower birthweight, younger gestational age), showed less compliance and more defiance, less optimal effortful attention skills, and less ability to wait in a delay of gratification task.
- ◆ Mothers who experienced more sociodemographic risks such as poverty, unemployment, and giving birth as a teen were the most likely to report elevated depressive symptoms prior to NICU discharge, to experience increasing or high stable depression trajectories over time, and to have toddlers who exhibited less turn-taking, less effortful attention, and less optimal cognitive development at 24 months postterm.

Implications for Practice and Research

These findings have several potential implications for practice and research with high risk infants and their families. First, prevention programs designed to promote optimal self-regulation in children born preterm or low birthweight may want to consider the possibility of screening mothers for elevated depressive symptoms prior to the infant's NICU discharge and providing support and options for evaluation and treatment of clinically significant depression, particularly when infants are born earlier and with lower birthweights. Research should examine this type of screening and targeted intervention to determine its effectiveness in improving child and family outcomes over time.

Because maternal sociodemographic risks predicted maternal depressive symptoms at NICU discharge and chronic or increasing patterns of depression over time in addition to children's effortful control skills, families experiencing multiple SES risks should be supported and monitored over time. Practitioners and researchers should be mindful of the larger context of PT/LBW development when designing intervention and research programs.

In our study, girls born PT/LBW appeared susceptible to developing internalizing problems and inhibition, whereas boys born PT/LBW appeared susceptible to developing defiance, impulsivity, and attention problems. Gender may be important regarding the types of screening and interventions that are initiated to promote these processes in these vulnerable children. We are currently following these children to school age to determine whether these early self-regulatory skills are associated with later diagnoses, such as ADHD, LD, and anxiety disorders.