



Trajectories of Externalizing and Internalizing Behaviors in Preterm Children Admitted to a Neonatal Intensive Care Unit

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Objective To examine the trajectories of internalizing and externalizing behavior problems of preterm children between 16 months and 6 years of age and predictors of trajectories, including gestational age, child dysregulation, maternal depression, socioeconomic status, and parenting.

Study design This longitudinal study followed 148 children and their mothers from neonatal intensive care unit discharge until 6 years of age. Gestational ages ranged from 23 to 36 weeks. The study included assessment of maternal-reported behavior problems, maternal depression, neonatal and socioeconomic characteristics, and observations of dysregulated behavior and parenting. Trajectories were identified with a semiparametric group-based analytic method, and multinomial logistic regression was used to identify significant risk factors.

Results Three distinct trajectories for preterm children were found for both internalizing and externalizing behavior problems. For the 2 groups with greater behavior problems (groups 1 and 2), trajectories reached their peak between 24 and 36 months of age, then leveled off or decreased. Group 3 showed a stable low level of externalizing behaviors, and a low, but slightly increasing level of internalizing behaviors. Maternal depression, child dysregulation, gestational age, and socioeconomic challenges were identified as risk factors that predicted less optimal behavior problem trajectories.

Conclusions Children born prematurely followed 1 of 3 distinct developmental trajectories for both internalizing and externalizing behavior problems. The most severe behavior problems started early in development and were associated with increased child dysregulation, maternal depression, and lower socioeconomic status. These findings have implications for screening and monitoring preterm children. (*J Pediatr* 2017;187:111-8).

Pretermaturity (birth at <37 weeks of gestation) and admission to a neonatal intensive care unit (NICU) are associated with medical complications,¹ increased rates of intellectual disability, attention difficulties, and language and motor problems,²⁻⁵ but links with child behavior problems have been less consistent. Externalizing behavior problems are marked by aggression and disruptive behavior, whereas internalizing behaviors include withdrawal, depression, and anxiety.⁶⁻⁸ Three reviews indicate that preterm children have increased rates of externalizing and internalizing behaviors compared with children born at full term,^{2,3,9} but reviews comparing children born very preterm (<32 weeks of gestation) and full-term children have not always found these differences.¹⁰ These findings may reflect a “paradox of prematurity”¹¹ wherein late preterm children (34-36 weeks of gestation) may be at greater risk for some problems than children born very preterm.^{11,12} Studies at single time points may limit our understanding, whereas examining trajectories may allow for earlier identification of at-risk children.¹³⁻¹⁸

Multiple factors have emerged as potential predictors of behavior problems. Dysregulated emotions (ie, impulsivity, emotional lability) may be important precursors for children who are compromised developmentally.^{19,20} Preterm infants are also at risk for experiencing more dyadic interactional difficulties, including more intrusive parenting, than full-term children.²¹ In prior studies of preterm children, negative, insensitive mothering has predicted greater externalizing behaviors at 2 and 6 years of age.^{12,22} Mothers of preterm infants are at risk for depression,²³ and these increased depressive symptoms predict less optimal parenting²⁴ and more child behavior problems.⁴ The current study examined the trajectories of internalizing and externalizing behavior problems between 16 months and 6 years of age in preterm children admitted to an NICU and how those trajectories were affected by early child and family factors. By identifying factors predictive of suboptimal behavioral trajectories, pediatricians may be able to better monitor and screen preterm children for preventive intervention, as well as provide anticipatory guidance to families.

BIC	Bayesian information criterion
CBCL	Child Behavior Checklist
CES-D	Center for Epidemiologic Studies Depression Scale
NICU	Neonatal intensive care unit
SES	Socioeconomic status

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Methods

There were 181 preterm infants and their mothers recruited from 3 NICUs. Infants were born at <37 weeks of gestation, had no congenital malformations, prenatal drug exposures, or significant neurologic findings, and had mothers ≥ 17 years of age who read English. For multiple births, 1 child was selected randomly to participate. Of the 181 participants, 3 were excluded owing to later identification of a grade IV intraventricular hemorrhage, 4 were excluded because the children were born at full term, and 25 were excluded because they did not have Child Behavior Checklists (CBCLs) completed at 2 time points, the minimum number suggested for the group-based analyses,²⁵ for a total sample of 148 dyads.

Families were enrolled after receiving institutional review board approval. Before NICU discharge, mothers completed questionnaires and medical records were reviewed by nurses. Gestational age was collected from the medical records. At 16, 24, and 36 months of age (corrected for prematurity), mothers completed questionnaires, the child was assessed, and dyads were videotaped playing in the laboratory. Visits were scheduled within 2 weeks of corrected age. When their children were 6 years of age, mothers completed a 20- to 25-minute phone interview and questionnaires.

Measures

Child Behavior Problems. Mothers completed the Preschool CBCL (1.5-5.0 years of age)⁶ when their children were 16, 24, and 36 months and the School-Age CBCL (6-18 years of age)⁷ at 6 years of age. The CBCL has been widely used and validated with preterm samples.⁹ Although the CBCL was collected at 16 months corrected for gestational age, the average chronological age of children was 18.1 months (range 16.4-21.5), and the gestational age was unrelated to CBCL score at any time point. The t-scores for internalizing and externalizing problem scales were used owing to differences in number of items between the preschool (99 items) and school-age versions (113 items).⁷

Parent-Child Interactions. Interactions at 16 months of age were coded using 3 established subscales from the Parent Child Early Relational Assessment.²⁶⁻²⁸ The Parent Child Early Relational Assessment assesses the frequency, duration, and intensity of affect and behaviors of parent-infant dyads during 5 minutes of play. Each variable is coded from 1 (negative quality) to 5 (positive quality). Higher scores indicate more positive parenting, less negative parenting, and less dysregulation.

Positive parenting includes tone of voice, positive affect, enjoyment, and quality of verbalizations (11 items; $\alpha = 0.90$). Negative parenting includes angry, hostile tone and mood, negative affect, and displeasure (5 items; $\alpha = 0.90$). Child dysregulation includes negative affect, irritable mood, and emotional lability (6 items; $\alpha = 0.88$). Ten percent of the sample at each time point was coded independently by 4 trained research assistants. Inter-rater reliability ranged from 0.83 to 0.97

across codes ($M = 0.88$). Kappa coefficients for individual codes ranged from 0.60 to 1.0 ($M = 0.83$).

Maternal Depression. Maternal depressive symptoms were measured at 16 months using The Center for Epidemiologic Studies Depression Scale (CES-D),²⁹ a 20-item self-report questionnaire on a 4-point scale ($M = 7.83$; $SD = 7.16$; range 0-40; $\alpha = 0.89$).

Child Cognitive Skills. Cognitive skills at 16 months were assessed with the Mental Developmental Index score from the Bayley Scales of Infant Development, 2nd Edition³⁰ ($M = 100$, $SD = 15$, $\alpha = 0.91$). In this sample, the average Mental Developmental Index score was 88.39 ($SD = 11.75$; range 50-122), with no significant outliers.

Maternal Socioeconomic Status. Mothers completed a demographic questionnaire at NICU discharge. Family income was initially skewed because 1 family reported income of \$500 000; it was top-coded to the next highest family income (ie, \$210 000). The socioeconomic status (SES) index was created by standardizing and averaging maternal education and family income ($\alpha = 0.74$).³¹

Results

A semiparametric group-based method^{25,32} was used to identify distinct trajectories of internalizing and externalizing behavior by identifying clusters of individuals with similar developmental pathways. Because the analytic sample was selected based on at least 2 data time points on the CBCL, there were no missing data for predictors. Behavior problems were modeled as a function of child age in months using the PROC TRAJ procedure in SAS (SAS Institute, Cary, North Carolina).³² Because behavior problems were approximately normally distributed, censored normal models were estimated. First, unconditional models were fitted for internalizing and externalizing behaviors to identify the number and shape of trajectory groups for each outcome. The Bayesian information criterion (BIC) was used to identify the best fitting model, with the lowest BIC score indicating better fit.²⁵ Posterior probabilities of group membership were evaluated, with a posterior probability of 0.70 or higher for individuals assigned to a given group considered evidence of acceptable model fit.²⁵

Next, multinomial logistic regression was used to examine predictors of trajectory group membership. The likelihood of membership in each trajectory group was compared with the likelihood of membership in the trajectory group with the highest level of symptoms over time (group 1, high), predicted by SES, child gestational age, child cognitive skills, maternal depression, and parent-child interactions during play (positive parenting, negative parenting, child dysregulation). Group 1 was chosen as the initial reference group so that all analyses indicate contrast with the highest risk group, indicating factors that increase the likelihood of greater resilience and fewer behavior problems. Differences between groups

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