Restricted, Repetitive, and Reciprocal Social Behavior in Toddlers Born Small for Gestation Duration

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Objective To characterize restricted and repetitive behaviors (RRBs) and reciprocal social behaviors (RSBs) in a large sample of toddlers who represent a range of birth weights and gestation durations.

Study design A battery of questionnaires characterizing demographic information and measuring RRBs and RSBs were completed by parents of toddlers between the ages of 17-26 months (n = 1589 total; n = 98 preterm). The association between birth weight and/or gestation duration and the primary outcome measures (RRBs and RSBs as ascertained through the Repetitive Behavior Scale for Early Childhood and the Video-Referenced Rating of Reciprocal Social Behavior) were tested by using hierarchical multivariate multiple regression.

Results Toddlers born preterm and full term did not differ on RRBs or RSBs. However, there were significant associations between birth weight percentile for gestation duration (BPGD) and RRBs ($\beta = -2.1$, $P = .03$), above and beyond the effects of age, sex, and vocabulary production. Similarly, there was a significant association between BPGD and RSBs ($\beta = -1.8$, $P = .02$), above and beyond the effects of age, sex, and vocabulary production.

Conclusions These findings demonstrate that BPGD better predicted putative antecedents of adverse psychological outcomes—specifically, RRBs and RSBs—than gestation duration alone. These findings provide insight to the link between preterm birth and suboptimal behavioral/psychological outcomes and suggest that high birth weight, which may reflect a more optimal intrauterine environment, may serve as a protective factor irrespective of gestation duration. *(J Pediatr 2018;■■:■■-■■).*

C hildren born preterm are more likely to exhibit symptoms consistent with autism spectrum disorder (ASD),[1,2] and children born very preterm (<30 weeks of gestation) are at 3 times greater risk for developing psychiatric diagnoses, including anxiety disorders, attention-deficit/hyperactivity disorder, and ASD.[3] Moderate-to-late preterm birth (32-36 weeks of gestation) also is associated with cognitive, language, and motoric delays and deficits in social–emotional competence at 24 months.[4] Although isolating the effects of prematurity from low birth weight on cognitive outcomes is challenging, studies on children born preterm have identified low birth weight as a factor influencing the relationship between prematurity and language delays.[5] A meta-analysis examining cognitive and behavioral outcomes in children born preterm found that mean cognitive scores were proportional to birth weight and gestational age,[6] suggesting that both factors may contribute independently to psychiatric outcomes.

Although there is evidence demonstrating increased risk for adverse psychological outcomes in children born preterm, improved characterization of behavioral risk factors present before maladaptive patterns of behavior consolidate may augment early detection and intervention. This line of inquiry is complicated not only by the observed heterogeneity in clinical manifestation but also the exceptional variability observed among typically developing toddlers and children of preschool age. Measurement tools that better approximate meaningful dimensionality of complex behavior are needed for improved characterization of early emerging risk factors.

The objective of this study was to begin to address this gap by examining whether individual differences in complex behaviors vary as a function of gestation duration and birth weight. Restricted and repetitive behaviors (RRBs) include repetitive motor mannerisms, rituals and routines, circumscribed interests, and insistence on sameness behaviors. Although RRBs can be normative and transient in toddlers,[7,8] increased rates of RRBs can interfere with daily life, are associated with anxiety and phobias in 1- to 7-year-old children,[9] and are a common

ASD	Autism spectrum disorder
BPGD	Birth weight percentile for gestation duration
NICU	Neonatal intensive care unit
RSB	Reciprocal social behavior
RBS-EC	Repetitive Behavior Scale for Early Childhood
RRBs	Restricted and repetitive behaviors
vrRSB	Video-Referenced Rating of Reciprocal Social Behaviors

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feature in children diagnosed with ASD, anxiety disorders,[10] and other neurodevelopmental disorders.[7,11] Reciprocal social behaviors (RSBs) refer to emotionally appropriate and socially contingent communicative behaviors with others.[12] RSBs also emerge in early childhood and are disrupted in toddlers with ASD. Both behaviors span the typical-to-atypical continuum, are normally distributed within the population,[7,12] and when disrupted are associated with adverse behavioral/psychological outcomes. Taken together, these features make RRBs and RSBs good targets for identifying individual differences that may be indicative of early risk for adverse psychological outcomes in children born preterm. A critical first step is to characterize profiles of these complex behaviors early in development in such children.

Toward this goal, we used data from a large community sample of 1589 toddlers that were collected to characterize individual differences in RRBs and RSBs. Of the 1589 toddlers, 98 (6.2%) were born preterm (<37 weeks of gestation). We aimed to examine group differences in RRBs and RSBs and to characterize how individual differences in RRBs and RSBs vary as a function of continuous measures of gestation duration and birth weight.

Methods

Parents of toddlers between 17 and 26 months (n = 4268), recruited from the University of Minnesota Institute of Child Development participant registry, were invited to participate in a study about their child's development between June 2015 to July 2016. The study was approved by the University of Minnesota Human Research Protection Program and institutional review board (#1501S61261), and parents of all participants provided informed consent and permission for their child to participate in this research study. Of the 4268 invited, 2112 (49.5%) chose to participate and completed at least 1 questionnaire. The final sample included 1589 children (833 male), including 98 infants born preterm at 29-36 weeks of gestation, with complete and reliable data (for more information on recruitment and attrition and exclusion, see **Figure 1**, **Table I**, and the **Appendix**; available at www.jpeds.com). A follow-up questionnaire was then sent to parents of toddlers born preterm to characterize additional perinatal risk factors (**Appendix**).

Measures of Birth Weight, Gestation Duration, and Birth Weight Percentile for Gestation Duration
Birth weight was determined through parent report. Gestation duration was determined by computing the difference between the child's expected date of birth and their actual date of birth. Parent report of both birth weight and expected date of birth have been shown to be reliable when compared with medical records 10-15 years postbirth.[13] Birth weight percentile for gestation duration (BPGD) was calculated via the Fenton growth chart for infants born preterm.[14] Toddlers born preterm had significantly lower birth weights (M 2448.5 g, SD 527.5) than toddlers born full term (M 3555.5 g, SD 439.4), (mean difference = 1107.1 g, 95% CI 999.0-1215.1, $t = -20.4$,

$P < 1 \times 10^{-15}$, $d = 2.5$) but were statistically equivalent in BPGD (mean preterm = 54.7%, mean full term = 56.4%, $t = -0.68$, $P = .5$, $d = 0.1$).

Outcome Measures
Repetitive Behavior Scale for Early Childhood (RBS-EC). The RBS-EC[7] is a 34-item parent-report questionnaire that is a downward-extension of the Repetitive Behavior Scale–Revised,[10] with good-to-excellent psychometric properties and evidence of validity and reliability[7] (based on a sample of toddlers that partially overlaps with the present sample). The questionnaire is intended to capture normative variation in young children (for distributions of RBS-EC scores in the present sample, see **Figure 2**, A [available at www.jpeds.com], and the **Appendix**). Each item contributes to 2 measures: items endorsed and frequency score. These measures can be summed into an overall composite measure (scored 0-34) or disaggregated into 4 psychometrically validated subscale scores: Repetitive Motor (scored 0-9), Ritual and Routine (scored 0-10), Restricted Behavior (sored 0-8), and Self-directed behavior (scored 0-7). See http://www.cehd.umn.edu/edpsych/research/resources/rbs-ec/ for access to the instrument.

Video-Referenced Rating of Reciprocal Social Behavior (vrRSB).[12] The vrRSB is a 48-item parent questionnaire designed for 18- to 30-month-old subjects and is a downward extension of the Social Responsiveness Scale.[15] The first 13 items refer to a video-displayed exemplar (ie, a typically developing 19-month-old child displaying reciprocal social and communicative behaviors) and ask parents to rate whether their child displays the same behaviors on scale of 0 (not at all) to 4 (more than child in video). The remaining 14-48 items ask parents to check the box that best describes their child's behavior over the past month from 0 (not true) to 4 (almost always true). Greater scores on the vrRSB represent lower developmental capacity for RSBs (for distributions of vrRSB scores in the present sample, see **Figure 2**, B [available at www.jpeds.com] and the **Appendix**).

Vocabulary Production. A 400-item checklist measuring expressive vocabulary from the MacArthur-Bates Communicative Development Inventory[16] was used to generate a composite score of expressive language. Parents of toddlers born preterm reported a lower number of words produced (M 86 words, SD 95) than toddlers born at full term (M 108 words, SD 104), (mean difference = 22, 95% CI 3-42, $t = -2.2$, $P = .03$, $d = 0.2$). Although this effect size was small, words produced was included as a control variable in the models as a proxy for overall language ability.

Statistical Analyses
To determine whether birth weight, gestation duration, or BPGD best predicted RRBs and RSBs, we used 3 series of hierarchical multiple multivariable regression analyses using R 3.3.1 (R Core Team; R Foundation for Statistical Computing, Vienna, Austria) via the *stats* package. All 3 predictor variables were continuous measures.[17]