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Behavior Disorders in Extremely Preterm/Extremely Low Birth Weight Children in Kindergarten

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Abstract

Objective—To examine the prevalence of behavior disorders in a 2001–2003 birth cohort of extremely preterm/extremely low birth weight (EPT/ELBW, <28 weeks gestational age and/or <1000 g) children in kindergarten.

Method—We compared 148 EPT/ELBW children to 111 term-born normal birth weight (NBW) classmate controls on reports of psychiatric symptoms obtained from parent interview (P-ChIPS), parent and teacher ratings of behavior (CBCL, TRF, BRIEF), and teacher ratings of social functioning (SSBS-2). Associations of behavior disorders with global cognitive ability and tests of executive function were also examined within the EPT/ELBW group.

Results—Rates of ADHD Combined on psychiatric interview were about twice as high for the EPT/ELBW group than for the NBW group, OR (95% CI)=2.50 (1.34, 4.68), $p=.004$. The EPT/ELBW group also had much higher rates of teacher-identified disorders in attention, behavior self-regulation, and social functioning, with odds ratios (95% confidence intervals) ranging from 3.35 (1.64, 6.83) to 18.03 (4.12, 78.94), all $p's < .01$. ADHD and impaired behavior self-regulation were associated with deficits on tests of executive function but not with global cognitive impairment.

Conclusions—The findings document elevated rates of disorders in attention, behavior self-regulation, and socialization in EPT/ELBW children and suggest that deficits on tests of executive function are associated with some of these disorders. Early identification and intervention for these disorders are needed to promote early adjustment to school and facilitate learning progress.

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Conflicts of Interest: An author is one of the developers of the psychiatric interview used in this study and receives royalties from the sale of this measure.

INTRODUCTION

Continued advances in neonatal intensive care have led to increased rates of survival in extremely preterm or very low birth weight children, with gestational age (GA) <28 weeks or birth weight <1000 g.¹ These cohorts are at higher risk than term-born normal birth weight (NBW, ≥37 weeks GA and ≥2500 g) children for developmental problems ranging from neurosensory disorders and global intellectual disability to more subtle disturbances in cognition, learning, and behavior.^{2,3} Rates of behavior problems are up to four times higher in EPT/ELBW children than in their NBW peers.^{3,4} The most commonly reported problems are attention deficits, internalizing symptoms (anxiety, depression, withdrawal, somatic complaints), and difficulties in social functioning.²⁻⁷ Externalizing symptoms (oppositional behavior, conduct problems, aggression) are less consistently reported.^{8,9}

Internalizing and externalizing symptoms and problems in self-regulation and social functioning in preterm/low birth weight cohorts have been identified as early as 2 years of age,^{10,11} suggesting that the behavior difficulties observed in older children may have been present since early childhood. Gray et al.¹² found that 21% of their sample of 3-year-old preterm low birth weight children had behavior ratings in the clinical range. Similarly, Rose et al.¹³ found that 30% of 3-year-old <1500 g birth weight children had elevated ratings of behavior problems compared with 18% of a NBW group. In both of the latter studies behavior problems persisted when children were followed to early school age. Other research has also documented more attention and social problems in preterm children compared with term-born controls at early school age (ages 5 and 6 years).¹⁴⁻¹⁶

The primary aim of this study was to assess the types and extent of behavior disorders in a 2001–2003 birth cohort of EPT/ELBW children during this first year in school compared with NBW classmate controls. We hypothesized that the EPT/ELBW group would have higher rates of several types of behavior abnormalities compared with NBW controls, including attention deficit/hyperactivity disorder (ADHD), internalizing disorders, and deficits in behavior self-regulation and social functioning.^{3,4,16-18} We anticipated higher rates of these disorders in the EPT/ELBW group even when excluding children with neurosensory deficits or low global cognitive ability.

A secondary aim was to determine if impairments in tests of global cognitive ability or executive function increase the risk for behavior disorders in EPT/ELBW children at school entry. Executive function consists of skills that support goal-directed behavior, including response inhibition, mental flexibility, and working memory.^{19,20} Deficits in these skills are common in EPT/ELBW children and are observed even in children without global cognitive impairment.¹⁹⁻²¹ Based on findings relating performance on tests of global cognitive ability and executive function to behavior outcomes in preterm samples,^{15,22-24} we hypothesized that deficits on these measures would be associated with higher rates of behavior and social difficulties.

To our knowledge no study has examined behavior outcomes in EPT/ELBW children all of whom were attending kindergarten for the first time. By focusing on first-time kindergarteners we were able to document behavior problems evident at this critical transitional period and ensure that the children were at a similar stage of schooling. Awareness of behavior problems is especially important at school entry because of their association with subsequent learning difficulties and the opportunities this awareness provides for earlier and more effective interventions.^{25,26} Kindergarten is the first year that many children are expected to meet more formal expectations for behavioral self-control and the first opportunity for children who have not been previously identified with special needs to receive assessment and intervention services. This is also one of the few studies to

examine behavior problems using a psychiatric interview and ratings of behavior self-regulation and social functioning.^{15–18} Other unique features include appraisal of outcomes in terms of both rates of behavior disorders and symptom severity and examination of deficits on executive function tests as indicators of increased risk for these disorders.

METHODS

Sample

The EPT/ELBW group consisted of children with <28 weeks GA and/or <1000 g birth weight born between 2001 and 2003 and treated in the neonatal intensive care unit of Rainbow Babies & Children's Hospital in Cleveland, Ohio. Of the 198 children without congenital abnormalities or infections who survived, 148 (75%) were recruited for this study. Reasons for nonparticipation included failure to locate families (n=21), moves out of the region (n=16), refusal to participate or no-shows (n=5), and questions regarding child custody or non-English-speaking families (n=8). Comparison of participants to the 50 survivors who did not participate did not indicate differences in sex, race, or neonatal characteristics. Recruitment was staggered across several years so that all children could be assessed during their first year in kindergarten. Most of the children were in regular education classrooms (n=129) with a minority either in full-time special education programs (n=16) or home-schooled (n=3).

The comparison group was composed of 111 term-born NBW children recruited from the same classrooms as the EPT/ELBW children (n = 93) or from other kindergarten classrooms (n = 18). To recruit controls, flyers were sent home to parents of all classmates of EPT/ELBW children attending regular classrooms. Once parents had granted permission for study contact, we recruited the student who most closely matched each EPT/ELBW child based on sex, age at testing, and ethnicity. The priority in matching was to recruit an NBW child of the same sex and similar age at testing as the EPT/ELBW child, with matching on ethnicity nearly always achieved after matching on these factors. Controls were not recruited for EPT/ELBW children who were home-schooled (n=3) or attending full-time special education programs (n=16). The reason for these exclusions was to ensure that teacher ratings would be completed by persons aware of age standards for behavior and social skills. Controls were not identified for an additional 18 EPT/ELBW children attending regular classrooms due to school or teacher refusals (n=6), difficulties in identifying appropriate matches (n=7), or locations too distant from the medical center (n=5).

Table 1 summarizes neonatal and demographic characteristics for the EPT/ELBW and NBW groups. The groups did not differ significantly in sex, race, age at assessment, time in school when teacher ratings were completed, or socioeconomic status (SES) as defined by a mean of the sample z scores for maternal education, caregiver occupation (averaged for two-parent households),²⁷ and census-based median family income.²⁸ As reported previously,²⁹ more EPT/ELBW children compared with NBW controls had early interventions services (83% vs. 13%, $p<.001$) but the groups were similar in rates of participation in daycare (49% vs. 51%) and preschool (84% vs. 85%).

Procedures and Measures

Children were given tests of global cognitive ability and executive function while parents completed child behavior ratings and a structured psychiatric interview. Following testing, research assistants visited the children's schools to obtain teacher ratings of child behavior. Additional kindergarten assessments of the child's academic achievement and neuropsychological skills completed as part of the larger study revealed deficits in the EPT/ELBW group relative to NBW controls in academic achievement and a broad range of

neuropsychological skills.^{29,30} Information on birth weight status was not shared with child examiners or teachers. However, because research assistants who conducted parent interviews also were responsible for recruitment, interviewers were not masked to birth status. The research was approved by the institutional review board of University Hospitals Case Medical Center and informed parental and teacher consent were obtained in writing prior to participation.

Child behavior ratings included the Child Behavior Checklist and Teacher's Report Form (CBCL and TRF),³¹ parent and teacher versions of the Behavior Rating Inventory of Executive Function (BRIEF-parent and BRIEF-teacher),³² and School Social Behavior Scales, 2nd Edition (SSBS-2).³³ Each of these scales has documented reliability and validity in identifying behavior problems in clinical populations. The CBCL and TRF survey a broad range of behavior and social-emotional problems whereas the BRIEF assesses behavioral indications of difficulties in executive function and self-regulation at home and school. The BRIEF consists of two composite indices. The Behavioral Regulation Index (self-regulation) comprises the subscales Inhibit (controlling impulses), Shift (shifting attentional focus), and Emotional Control (modulating emotional responses). The Metacognition Index (organizational and self-monitoring skills) comprises the subscales Initiate (beginning activities), Working Memory (keeping information in mind while completing activities), Plan/Organize (using strategies for attaining goals), Organization of Materials (keeping belongings tidy), and Monitor (checking work and being aware of effects of one's own behavior). The SSBS-2 is a teacher rating of two composite dimensions of student behavior. Social Competence comprises the subscales Peer Relations (e.g., interacts, joins in), Self-Management/Compliance (e.g., cooperates, controls feelings), and Academic Behavior (e.g., listens, completes work). Antisocial Behavior comprises the subscales Hostile (e.g., disrespects others, has tantrums), Antisocial/Aggressive (e.g., aggressive, gets into trouble), and Defiant/Disruptive (e.g., demanding, impulsive).

Disorders on the CBCL and TRF were defined as age- and sex-based T-scores falling in the borderline clinical range or above on DSM-Oriented scales ($\geq 93^{\text{rd}}$ percentile). Disorders on the BRIEF were defined as age and sex-based T-scores of potential clinical significance (≥ 65) on the composite indices and subscales. Abnormal ratings on the SSBS-2 were identified by age-related percentiles in the at-risk or high-risk range on the composite scales and subscales. Higher scores on SSBS-2 Social Competence scale and subscales reflect higher functioning whereas higher scores on all other behavior measures reflect more problems.

The Children's Interview for Psychiatric Syndromes-Parent Form (P-ChIPS) was also administered to assess childhood behavioral, anxiety, and mood disorders and other syndromes using a highly structured "yes-no" question format.³⁴ Compared with clinical diagnoses, the P-ChIPS has an average sensitivity and specificity of .87 and .76, respectively, across diagnostic categories.^{35–39} This measure was developed for use with children 6–18 years of age but is appropriate for slightly younger children who attend school. The P-ChIPS provides information on the presence/absence of disorder and symptom count for each syndrome. Cut-offs for clinical syndromes are based on DSM-IV criteria for symptoms counts and duration. The P-ChIPS uses a highly structured format that allows for administration by research assistants with appropriate training. Examiners were trained to reliability in administration of the P-ChIPS and scoring reliability was confirmed by review of a random selection of 25 video-taped interviews, with 96%–100% agreement on the presence/absence of syndromes and 92%–100% agreement on symptoms counts.

Symptom counts and T-scores were correlated ($p < .05$) for the majority of the corresponding scales of the P-ChIPS, CBCL, and TRF (e.g., ADHD, Oppositional Defiant Disorder/

Problems) (Pearson r 's .22–.71), as were T-scores for corresponding scales of the BRIEF-parent and BRIEF-teacher (Pearson r 's .16–.39). There was also significant agreement in the corresponding disorders identified by the three measures (Kappa's .11–.46). The modest associations between the measures suggest distinct but related measures of behavior.

Global cognitive ability was estimated by the Brief Intelligence Assessment score (BIA) from the Woodcock Johnson Tests of Cognitive Abilities, 3rd edition.⁴⁰ The BIA is an age-standardized score with good reliability that correlates with other measures of general intelligence.⁴⁰ As previously reported,³⁰ the EPT/ELBW group had a lower BIA than the NBW group ($p < .001$), with adjusted means (standard errors) of 87.69 (1.57) and 103.91 (1.81), respectively.

Tests of executive function included measures of inhibition, mental set switching, and working memory developed by one of the authors (KAE) and her colleagues for use with young children.^{41,42} Shape School requires naming colored shapes drawn as cartoon-like figures according to different rules (e.g., name only the smiling characters but not the frowning ones to assess inhibition, and name the colors of the ones with hats and the shapes of those without hats to assess set switching). Preschool Trails Test—Revised requires finding and stamping pictures of different sized dogs and their correspondingly sized bones in order. Inhibition on this task is assessed by having the child ignore the bones or other stimuli while stamping just the dogs, and set switching is assessed by having the child alternate between stamping the dogs and their bones. Performance on Shape School and Preschool Trails-Revised is assessed in terms of efficiency scores that take into account both errors and completion time. The Test of Inhibition and Attention is a computerized task requiring pressing of the space bar to pictures of fish (targets) but not to pictures of sharks (non-targets). The task involves two conditions, one in which non-targets are rare to assess inhibition (Go No-Go) and the other in which non-targets are frequent to assess selective attention (Continuous Performance Test). The score for each condition is the child's ability to detect the target (d') as measured by signal detectability theory. Nebraska Barnyard is a measure of working memory that requires children to reproduce sequences of names read by the examiner by touching corresponding locations on a computer screen. Sequences are presented in increasing lengths and the child's score is the maximum length retained. Our previous report provides further details on these procedures and documents deficits in the EPT/ELBW group compared with NBW controls on each of the tests.³⁰

Data Analysis

Logistic regression was used to examine group differences in rates of disorders controlling for the effects of sex, SES, and race. Moderating effects of sex and SES were explored by including interactions of these factors with group in initial models. Three series of secondary group comparisons were also conducted. In the first series children with neurosensory disorders or a deficit in global cognitive ability as defined by BIA scores below the 10th percentile for age (standard score < 81) were excluded. The aims of these analyses was to determine if group differences could be demonstrated in children without more severe or pervasive impairments. In the second series, the 19 EPT/ELBW children who were home schooled or in full time special education programs were excluded to investigate outcomes for EPT/ELBW children attending regular classrooms. The final series was limited to measures for which there were comparable parent and teacher forms (CBCL and TRF, BRIEF-parent and BRIEF-teacher). Only children who had ratings from both parents and teachers were included in these comparisons to determine if parent and teacher ratings would yield similar findings. Mann Whitney U tests were also conducted to examine dimensional differences on P-ChIPS symptom counts and T-scores for the parent and teacher ratings scales (the non-normal distribution of these scores precluded use of parametric tests). In a final series of analyses, logistic regressions controlling for sex, race,

and SES were conducted to examine associations of deficits in global cognitive ability and in executive function with behavior disorders in the EPT/ELBW group. The latter deficits were defined as scores below the 10th percentile for the NBW group. Because comparisons were made on multiple behavior measures an alpha of .01 was applied.

RESULTS

Group Differences in Rates of Disorders

Based on parent report, the EPT/ELBW group had higher rates of ADHD Hyperactive-Impulsive and Combined syndromes and of significant elevations on two BRIEF-parent Metacognition scales (Table 2) compared with NBW controls. The EPT/ELBW group also had higher rates disorders on the ADHD Inattentive scale of the TRF, all BRIEF-teacher Metacognition scales, and SSBS-2 Social Competence, Peer Relations, and Academic Behavior (Table 3). The rates of these disorders in the EPT/ELBW group were about double those found in NBW controls for P-ChIPS ADHD diagnoses, nearly five times higher for the ADHD Inattentive on the TRF, and more than five times higher for some scales of the BRIEF-parent, BRIEF-teacher, and SSBS-2. More EPT/ELBW children ($n=44$, 31%) than NBW controls ($n=12$, 11%) had multiple P-ChIPS diagnoses, odds ratio (95% confidence interval) = 3.64 (1.79, 7.42), $p<.001$.

Based on teacher reports, group differences in rates of several disorders remained significant in analyses that excluded children with neurosensory disorders or a deficit in global cognitive ability, as well as in analyses that excluded the EPT/ELBW children not in regular classrooms (see Table 3 notations). Group comparisons on the CBCL, TRF, BRIEF-parent, and BRIEF-teacher that included only children with both the parent and teacher ratings revealed differences only on the teacher scales.

Analysis failed to indicate moderating effects of sex or SES on group differences. However, males had higher rates of disorders on the SSBS-2 Self Management/Compliance and Antisocial Behavior scales than females. In addition, lower SES was associated with a higher rate of ADHD Hyperactive-Impulsive on the P-ChIPS and minority race with higher rates of disorders on the BRIEF-parent Metacognition Index and BRIEF-teacher Working Memory scale.

Group Differences in Dimensional Measures of Behavior and Social Functioning

Findings from analyses of symptom counts and T-scores revealed group differences that corresponded in large part to those found in comparing the groups on rates of disorders (Table 4). However, these analyses also revealed group differences not evident in examining rates of disorder, including higher symptom counts for the EPT/ELBW group on P-ChIPS ADHD Inattentive, Oppositional Defiant Disorder, and Enuresis; higher T-scores on the ADHD Attention Problems scale of the CBCL, Affective Problems scale of the TRF, Behavior Regulation Index and Inhibit and Shift scales of the BRIEF-teacher, and Defiant/Disruptive subscale of the SSBS-2; and lower T-scores on the Self Management/Compliance subscale of the SSBS-2.

Several of the differences remained significant when excluding children with neurosensory disorders or a deficit in global cognitive ability (see Table 4 notations). With these children excluded, the EPT/ELBW also had higher T-scores for Anxiety Problems on the TRF. Several differences also remained significant when excluding EPT/ELBW children not in regular classrooms. A similar pattern of group differences was evident in comparisons on the CBCL, TRF, BRIEF-parent, and BRIEF-teacher that were restricted to children with both parent and teacher ratings.

Association of Test Deficits with Behavior Disorders in the EPT/ELBW Group

Results from logistic regressions failed to reveal associations of deficits on the BIA in the EPT/ELBW group with rates of disorder on any of the behavior or social measures. However, deficits on tests of executive function were associated with higher rates of ADHD Combined, ADHD Inattentive, and Enuresis on the P-ChIPS and with higher rates of T-scores ≥ 65 on several of the BRIEF-parent and BRIEF-teacher scales (Table 5).

DISCUSSION

As EPT/ELBW children reach school age, it is important to identify the types of behavior and social impairments they have at school entry. Evaluations conducted during the kindergarten year in school indicated that the EPT/ELBW group had higher rates of ADHD and deficits in social functioning at school than NBW classmates. Approximately twice as many EPT/ELBW children compared with NBW controls met criteria for diagnoses of ADHD Hyperactive-Impulsive (28% vs. 13%) and ADHD Combined (33% vs. 16%) on a structured psychiatric interview. Teacher ratings in the clinical range on the ADHD Inattentive scale were nearly five times higher in the EPT/ELBW group (19% vs. 4%). The rates of these disorders are comparable to those reported in other studies.¹⁵ The EPT/ELBW group also had higher rates of problems in behavioral organization and self-monitoring (i.e., metacognition). Group differences in rates of disorders in metacognition and social functioning remained significant when excluding children with neurosensory disorders or a deficit in global cognitive ability, indicating increased risks for these disorders even among EPT/ELBW children without pervasive impairment.

The EPT/ELBW group had more psychiatric symptoms and higher ratings of behavior or social problems on scales that failed to reveal group differences in rates of disorder. Specifically, the EPT/ELBW group had more parent-reported symptoms of ADHD-Inattentive, Oppositional Defiant Disorder, and enuresis and higher teacher ratings of emotional disturbance, problems in behavior self-control, and defiant/disruptive behaviors. These results confirm both internalizing and externalizing behavior problems in this population. Dimensional differences on several measures of behavior problems, metacognition, and social functioning remained significant when excluding children with neurosensory disorders or a deficit in global cognitive ability. The results are consistent with other evidence for subclinical elevations in behavior and social problems in EPT/ELBW children.^{3,4,9,43}

The types of behavior and social disorders found in this sample have been identified in previous research on EPT/ELBW children conducted at early school age.^{14–16} The present study demonstrates that these disorders continue to be evident even in children born in the early 2000s, a period during which rates of neurodevelopmental impairment have declined.⁴⁴ Past studies document similar disorders in both younger and older preterm children,^{4,6,7,10–13,22,24,45} suggesting that behavior problems emerge early in childhood and persist over time. The EPT/ELBW group's higher rate of ADHD Inattentive but not ADHD Hyperactive/Impulsive or Oppositional Defiant Problems on the TRF is also consistent with past observations of more problems in attention than in hyperactivity or externalizing behaviors, especially on teacher reports.^{3–7,9,22–24} In addition, however, the EPT/ELBW group had a higher rate of ADHD Hyperactive-Impulsive on the P-ChIPS, higher symptom counts for Oppositional Defiant Disorder on the P-ChIPS, and higher teacher ratings of Defiant/Disruptive problems. The results accord with those of Samara et al.¹⁵ in documenting a wide range of behavior problems in EPT/ELBW children at early school age.

Many of the group differences remained significant when considering only EPT/ELBW children in regular classrooms, providing new evidence that even those EPT/ELBW children

attending regular classes have more behavior problems than their classmates. In comparisons restricted to the subset of children in regular classrooms with both parent and teacher ratings, higher rates of behavior problems were more evident on the teacher ratings. Specifically, on rating scales with comparable parent/teacher forms (CBCL vs. TRF, BRIEF-parent vs. BRIEF-teacher), inattentiveness and problems in behavioral self-regulation were more often identified by teachers. The results suggest that teacher ratings, while generally consistent with those by parents, may be more likely to identify disorders in these areas at school entry and support efforts to obtain reports from both sources.

As observed in previous research, behavior problems were more prevalent in boys than in girls and in children with lower vs. higher SES.^{7,9,46} Contrary to some previous investigations,^{9,15} we did not find that the effects of extreme prematurity on behavior were more pronounced for boys than girls. The lack of a moderating effect of sex on group differences was unexpected given evidence for a greater vulnerability of males to complications of preterm birth and early childhood neurodevelopmental impairment,⁴⁷ though other studies have reported similar findings.^{7,22,24}

Performance of EPT/ELBW children on tests of executive function was related to diagnoses of ADHD Inattentive, ADHD Combined, and Enuresis as well as to behavioral indications of executive dysfunction. Contrary to several past studies,^{14,15,18,22–24} lower global cognitive ability was not associated with behavior or social problems in this EPT/ELBW cohort. This pattern of results suggests that executive function skills are more closely related to attention disorders in EPT/ELBW children than is overall intelligence.³ Recent findings showing that deficits on tests of executive function are associated with ratings of inattentive and overactive/impulsive behaviors in older preterm children support this interpretation.²³ Deficits in executive function skills have been identified in children with a wide range of clinical conditions and are viewed by many as being integral components of ADHD.^{48–51} Associations of tests of executive function with enuresis suggest that weaknesses in executive function either contribute directly to lack of bladder control or signal abnormalities in brain regions underlying this disorder.

To our knowledge this is the first study to document behavior and social outcomes of extreme prematurity in a sample of EPT/ELBW children all of whom were enrolled in kindergarten at the time of assessment. The data provide information on the likelihood of clinically relevant levels of behavior and social problems in our sample relative to base rates for peers from similar sociodemographic backgrounds. This study is also one of few to assess behavior self-regulation and social functioning at school, use a formal psychiatric interview to assess behavior outcomes,⁹ and investigate performance on tests of executive function in relation to behavior outcomes in young EPT/ELBW children. One advantage of using a structured psychiatric interview is that questioning is focused on behaviors that are relevant to diagnostic criteria. A further benefit is that the interview format helps to ensure parent understanding of questions and provides opportunities to clarify parent responses. The utility of the P-ChIPS was demonstrated in this study by its sensitivity to group differences in rates of ADHD diagnoses and the relation of these diagnoses to deficits on tests of executive function.

One of the study's limitations is that we were unable to recruit 25% of the surviving birth cohort of EPT/ELBW children treated at a single perinatal center. The absence of differences in background and neonatal status of the participants and non-participants suggests that the sample was representative of our regional population. However, behavior outcomes in our largely urban sample may not be representative of outcomes in other regions. Another concern is that the examiners who administered the P-ChIPS were not blind as to birth status. The P-ChIPS is a highly structured interview, syndromes identified

on interview were related to corresponding DSM-Oriented syndromes obtained from parent ratings of behavior, and inter-rater reliability for scoring of parent responses was high. Nevertheless, we cannot rule out the possibility that examiner bias contributed to group differences. A further limitation was the failure to include a measure of autism spectrum disorders, especially in view of recent findings suggesting increased symptoms of autism in EPT/ELBW children.^{3,4,22} Teacher ratings confirm elevated rates of social deficits in the EPT/ELBW group. Although social deficits are also associated with ADHD and deficits in executive function,^{52,53} it is unclear how many children met criteria for autism.

In summary, the results confirm adverse behavior and social consequences of extreme prematurity at school entry. These consequences are evident both at home and at school and include increased rates of ADHD, impaired social functioning, and poor self-control. The high rates of these disorders in kindergarten underscores the importance of screening EPT/ELBW children for behavior problems when they first enter school if not before.⁵⁴ Recognition of these disorders at school entry would assist parents and teachers in setting realistic expectations for the child and facilitate more timely behavior interventions. Early interventions are likely to be more effective than later ones and may mitigate the negative effects of behavior and social problems in kindergarten on children's subsequent academic learning.^{25,26} The findings also demonstrate associations of tests of executive function with disorders in attention and self-regulation in EPT/ELBW children. These associations demonstrate the utility of neuropsychological assessments in identifying children at risk for behavior disorders. Ongoing follow-up of our sample will help establish the stability of children's behavior disorders and their relation to subsequent academic progress. Based on previous findings we anticipate that attention disorders in kindergarten will forecast later problems in reading and mathematics.⁵⁵

Further efforts will be required to examine even earlier manifestations of behavior problems in this population and to design follow-up programs that help to insure that these problems are recognized as soon as they become evident and provide for continuity of care from birth through school age. A system of care such as a "medical home" would serve this purpose⁵⁶ and neuropsychological follow-up would be useful in tracking development. Additional research is also needed to examine biological and environmental risk factors, explore the neural basis of these problems and other developmental antecedents (e.g., social cognition and communication skills), and test behavior interventions.

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REFERENCES

1. Stoll BJ, Hansen NI, Bell EF, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics*. 2010; 126:443–456. [PubMed: 20732945]
2. Conrad AL, Richman L, Lindgren S, et al. Biological and environmental predictors of behavioral sequelae in children born preterm. *Pediatrics*. 2010; 125:e83–e89. [PubMed: 20008432]
3. Johnson S, Marlow N. Preterm birth and childhood psychiatric disorders. *Pediatr Res*. 2011; 69:11R–18R.
4. Hack M, Taylor HG, Schluchter M, et al. Behavioral outcomes of extremely low birth weight children at age 8 years. *J Dev Behav Pediatr*. 2009; 30:122–130. [PubMed: 19322106]

5. Aarnoudse-Moens CSH, Weisglas-Kuperus N, van Goudoever JB, et al. Meta-Analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. *Pediatrics*. 2009; 124:717–728. [PubMed: 19651588]
6. Anderson P, Doyle LW. the Victorian Infant Collaborative Study Group. Neurobehavioral outcomes of school-age children born extremely low birth weight or very preterm in the 1990s. *JAMA*. 2003; 289:3264–3272. [PubMed: 12824207]
7. Farooqi A, Hagglof B, Sedin G, et al. Mental health and social competencies of 10- to 12-year-old children born at 23 to 25 weeks of gestation in the 1990s: A Swedish national prospective follow-up study. *Pediatrics*. 2007; 120:118–133. [PubMed: 17606569]
8. Bhutta AT, Cleves MA, Casey PH, Cradock MM, Anand KJS. Cognitive and behavioral outcomes of school-aged children who were born preterm. *JAMA*. 2002; 288:728–737. [PubMed: 12169077]
9. Johnson S. Cognitive and behavioral outcomes following very preterm birth. *Semin Fetal Neonatal Med*. 2007; 12:363–373. [PubMed: 17625996]
10. Clark CAC, Woodward LJ, Horwood LJ, et al. Development of emotional and behavioral regulation in children born extremely preterm and very preterm: Biological and social influences. *Child Dev*. 2008; 79:1444–1462. [PubMed: 18826535]
11. Spittle AJ, Treyvaud K, Doyle LW, et al. Early Emergence of behavior and social-emotional problems in very preterm infants. *J Am Acad Child Adolesc Psychiatry*. 2009; 48:9099–10018.
12. Gray RF, Indurkha A, McCormick MC. Prevalence, stability, and predictors of clinically significant behavior problems in low birth weight children at 3, 5, and 8 years of age. *Pediatrics*. 2004; 114:736–743. [PubMed: 15342847]
13. Rose SA, Feldman JF, Rose SL, et al. Behavior problems at 3 and 6 years: Prevalence and continuity in full-terms and preterms. *Dev Psychopathol*. 1992; 4:361–374.
14. Delobel-Ayoub M, Arnaud C, White-Koning M, et al. Behavioral problems and cognitive performance at 5 years of age after very preterm birth: The EPIPAGE Study. *Pediatrics*. 2009; 123:1485–1492. [PubMed: 19482758]
15. Samara M, Marlow N, Wolke D. Pervasive behavior problems at 6 years of age in a total-population sample of children born at 25 weeks of gestation. *Pediatrics*. 2008; 122:562–573. [PubMed: 18762527]
16. Reijneveld SA, de Kleine MJ, van Baar AL, et al. Behavioural and emotional problems in very preterm and very low birthweight infants at age 5 years. *Arch Dis Child Fetal Neonatal Ed*. 2006; 91:F423–F428. [PubMed: 16877476]
17. Luu TM, Ment L, Allan W, et al. Executive and memory function in adolescents born very preterm. *Pediatrics*. 2011; 127:e639–e646. [PubMed: 21300680]
18. Hoy EA, Sykes DH, Bill JM, et al. The social competence of very-low birthweight children: Teacher, peer, and self-perceptions. *J Abnorm Child Psychol*. 1992; 20:123–150. [PubMed: 1593023]
19. Aarnoudse-Moens CSH, Smidts DP, Oosterlaan J, et al. Executive function in very preterm children at early school age. *Journal of Abnormal Child Psychology*. 2009; 37:981–993. [PubMed: 19488851]
20. Bayless S, Stevenson J. Executive functions in school-age children born very prematurely. *Early Hum Dev*. 2007; 83:247–254. [PubMed: 16837146]
21. Marlow N, Hennessy EM, Bracewell MA, et al. Motor and executive function at 6 years of age after extremely preterm birth. *Pediatrics*. 2007; 120:793–804. [PubMed: 17908767]
22. Johnson S, Hollis C, Kochhar P, et al. Psychiatric disorders in extremely preterm children: Longitudinal findings at age 11 years in the EPICure Study. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2010; 49:453–463. [PubMed: 20431465]
23. Mulder H, Pitchford NJ, Marlow N. Inattentive behavior is associated with poor working memory and slow processing speed in very pre-term children in middle childhood. *Br J Educ Psychol*. 2010; 81:147–160. [PubMed: 21391967]
24. Szatmari P, Saigal S, Rosenbaum P, et al. Psychopathology and adaptive functioning among extremely low birthweight children at eight years of age. *Dev Psychopathol*. 1993; 5:345–357.
25. Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *Am Psychol*. 2002; 57:11–127.

26. Flanagan KS, Bierman KL, Kam CM. Identifying at-risk children at school entry: The usefulness of multibehavioral problem profiles. *J Clin Child Adolesc Psychol.* 2003; 32:396–407. [PubMed: 12881028]
27. Hauser RM, Warren JR. Socioeconomic indexes for occupation: A review, update, and critique. *Sociolog Methodol.* 1997; 27:177–298.
28. [Accessed January 1, 2010–November 1, 2010] Federal Financial Institutions Examinations Council Geocoding System. Available at: <http://www.ffiec.gov/Geocode/default.htm>
29. Taylor HG, Klein N, Anselmo MG, et al. Learning problems in kindergarten students with extremely preterm birth. *Arch Pediatr Adolesc Med.* 2011; 165:819–825. [PubMed: 21893648]
30. Orchinik LJ, Taylor HG, Espy KA, et al. Cognitive outcomes for extremely preterm/extremely low birth weight children in kindergarten. *J Int Neuropsychol Soc.* 2011; 17:1067–1079. [PubMed: 21923973]
31. Achenbach, TM.; Rescorla, LA. Manual for the ASEBA school-age forms and profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families; 2001.
32. Gioia, G.; Isquith, P.; Guy, S., et al. BRIEF – Behavior Rating Inventory of Executive Function, Professional manual. Odessa, FL: Psychological Assessment Resources; 2000.
33. Merrel, K. Preschool and Kindergarten Behavior Scales—Second edition. Austin, TX: PRO-ED; 2002.
34. Weller, EB.; Weller, RA.; Teare, M., et al. Parent version—Children’s Interview for Psychiatric Syndromes (P-ChIPS). Washington, DC: American Psychiatric Press; 1999.
35. Teare M, Fristad MA, Weller EB, et al. Study I: Development and criterion validity of the Children’s Interview for Psychiatric Syndromes (ChIPS). *J Child Adolesc Psychopharmacol.* 1998; 8:205–211. [PubMed: 10214924]
36. Teare M, Fristad MA, Weller EB, et al. Study II: Concurrent validity of the DSM-III-R Children’s Interview for Psychiatric Syndromes (ChIPS). *J Child Adolesc Psychopharmacol.* 1998; 8:213–219. [PubMed: 10214925]
37. Fristad MA, Teare M, Weller EB, et al. Study III: Development and concurrent validity of the Children’s Interview for Psychiatric Syndromes-Parent Version (P-ChIPS). *J Child Adolesc Psychopharmacol.* 1998; 8:221–226. [PubMed: 10214926]
38. Fristad MA, Cummins J, Verducci JS, et al. Study IV: Concurrent validity of the DSM-IV Revised Children’s Interview for Psychiatric Syndromes (ChIPS). *J Child Adolesc Psychopharmacol.* 1998; 8:227–236. [PubMed: 10214927]
39. Fristad MA, Glickman AR, Verducci JS, et al. Study V: Children’s Interview for Psychiatric Syndromes (ChIPS): Psychometrics in two community samples. *J Child Adolesc Psychopharmacol.* 1998; 8:237–245. [PubMed: 10214928]
40. Woodcock, RC.; McGrew, KS.; Mather, S. Woodcock-Johnson III Tests of Cognitive Abilities. Itasca, IL: Riverside Publishing; 2001.
41. Espy KA, Bull R, Martin J, et al. Measuring the development of executive control with the shape school. *Psychol Assess.* 2006; 18:373–381. [PubMed: 17154758]
42. Espy K, Cwik M. The development of a trail making test in young children: The TRAILS-P. *Clin Neuropsychol.* 2004; 18:411–422. [PubMed: 15739812]
43. Grunau R, Whitfield MF, Fay TB. Psychosocial and academic characteristics of extremely low birth weight (<800 g) adolescents who are free of major impairment compared with term-born control subjects. *Pediatrics.* 2004; 114:e725–e732. [PubMed: 15576337]
44. Wilson-Costello D, Friedman H, Minich N, et al. Improved neurodevelopmental outcomes for extremely low birth weight infants in 2000–2003. *Pediatrics.* 2007; 110:37–45. [PubMed: 17200269]
45. Botting N, Powls A, Cooke RWI, et al. Attention Deficit Hyperactivity Disorders and other psychiatric outcomes in very low birthweight children at 12 years. *J Child Psychol Psychiatry.* 1997; 38:931–941. [PubMed: 9413793]
46. Potharst ES, van Wassenaer AG, Houtzager BA, et al. High incidence of multi-domain disabilities in very preterm children at five years of age. *J Pediatr.* 2011; 159:79–85. [PubMed: 21349538]

47. Hintz SR, Kendrick DE, Vohr BR, et al. Gender differences in neurodevelopmental outcomes among extremely preterm, extremely-low-birthweight infants. *Acta Paediatr.* 2006; 95:1239–1248. [PubMed: 16982497]
48. Willcutt EG, Doyle AE, Nigg JT, et al. Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biol Psychiatry.* 2005; 57:1336–1346. [PubMed: 15950006]
49. Cataldo MG, Nobile M, Lorusso ML, et al. Impulsivity in depressed children and adolescents: A comparison between behavioral and neuropsychological data. *Psychiatry Res.* 2005; 136:123–133. [PubMed: 16125790]
50. Emerson CS, Mollet GA, Harrison DW. Anxious-depression in boys: An evaluation of executive functioning. *Arch Clin Neuropsychol.* 2005; 20:539–546. [PubMed: 15896566]
51. Nigg JT, Quamma JP, Greenberg MT, et al. A two-year longitudinal study of neuropsychological and cognitive performance in relation to behavioral problems and competencies in elementary school children. *J Abnorm Child Psychol.* 1999; 27(1):51–63. [PubMed: 10197406]
52. Riggs NR, Jahromi LB, Razza RP, et al. Executive function and the promotion of social-emotional competence. *J Appl Dev Psychol.* 2006; 27:300–309.
53. Rinsky JR, Hinshaw SP. Linkages between childhood executive functioning and adolescent social functioning and psychopathology in girls with ADHD. *Child Neuropsychol.* 2011; 17:368–390. [PubMed: 21390921]
54. Msall ME, Park JJ. The spectrum of behavioral outcomes after extreme prematurity: Regulatory, attention, social, and adaptive dimensions. *Semin Perinatol.* 2008; 32:42–50. [PubMed: 18249239]
55. Breslau J, Miller E, Breslau N, et al. The impact of early behavior disturbances on academic achievement in high school. *Pediatrics.* 2009; 123:1472–1476. [PubMed: 19482756]
56. Hintz SR, Kendrick DE, Vohr BR, et al. Community supports after surviving extremely low-birth-weight, extremely preterm birth. *Arch Pediatr Adolesc Med.* 2008; 162:748–755. [PubMed: 18678807]

Table 1

Perinatal and Demographic Characteristics of the EPT/ELBW and NBW Groups.

	EPT/ELBW Group (n=148)^a	NBW Group (n=111)^a
Perinatal data		
Birth weight in grams, mean (SD, range) ^b	818 (174, 485–1281)	3382 (446, 2500–4508)
Gestational age in weeks, mean (SD, range) ^b	26 (2, 23–32)	≥37
Multiple birth, n (%)	31 (21%)	0
Demographic data		
Age (years) at time of study, mean (SD, range) ^c	5.96 (0.37, 5.17–7.06)	5.96 (0.31, 5.31–6.86)
Age (years) at time of teacher ratings, mean (SD, range) [*]	6.18 (0.37, 5.56–7.20)	6.03 (0.31, 5.33–6.83)
Months in school at time of teacher ratings, mean (SD, range)	7.16 (1.75, 2.40–9.60)	7.11 (1.68, 2.40–9.60)
Male sex	68 (46%)	51(46%)
African American ^d	91 (61%)	61(55%)
Education of primary caregiver: ^e		
< high school	20 (14%)	14 (13%)
high school or GED	33 (22%)	16 (14%)
> high school	95 (64%)	81 (73%)
SES z-score composite, mean (SD, range)	−0.05 (1.02, −1.51–3.36)	0.07 (0.98, −1.56–3.43)

Abbreviations: EPT/ELBW = Extremely Preterm/Extremely Low Birth Weight; NBW = term-born Normal Birth Weight; GED = General Education Diploma; SES = socioeconomic status, defined as the mean of the sample z-scores for caregiver education, occupation, and median family income for area of residence based in 2000 US Census.⁴¹

^aSample sizes for teacher data were reduced to 110 EPT/ELBW children and 107 NBW controls due to home schooling (3 EPT/ELBW), participation of the child in a full-time special education classroom (16 EPT/ELBW), school or teacher refusals (8 EPT/ELBW), and failure to complete the assessments (11 EPT/ELBW, 4 NBW).

^bBirth weight and gestational age based on ultrasound dating and/or obstetric data for EPT/ELBW groups and on maternal report for NBW group; groups differed by definition.

^cChild testing, parents ratings, and psychiatric interview completed as part of the office visit.

^dAll others Caucasian except for 4 Asian (2 in each group)

^ePrimary caregiver was biological or adoptive mother for 143 (97%) of EPT/ELBW group and 105 (95%) of NBW group.

^{*}Significant group difference, $p < 0.01$.

Table 2

Rates of parent-reported behavior disorders in the EPT/ELBW (n = 148) and NBW (n = 111) groups.

Behavior Disorder	EPT/ELBW Group No. (%) ^a	NBW Group No. (%)	Adjusted Odds Ratio (95% CI)	p-value
Children's Interview for Psychiatric Syndromes, Parent Form (P-ChIPS) Clinical Syndromes:^b				
ADHD Combined	47 (33)	18 (16)	2.50 (1.34, 4.68)	.004*
ADHD Inattentive	30 (21)	10 (9)	2.64 (1.22, 5.72)	.014
ADHD Hyperactive-Impulsive	39 (28)	14 (13)	2.54 (1.27, 5.08)	.008*
Oppositional Defiant Disorder	27 (19)	13 (12)	1.65 (0.79, 3.44)	.184
Conduct Disorder	8 (6)	5 (5)	1.10 (0.34, 3.55)	.877
Specific Phobia	24 (17)	13 (12)	1.53 (0.73, 3.18)	.257
Social Phobia	9 (6)	1 (1)	7.63 (0.95, 61.40)	.056
Separation Anxiety Disorder	8 (6)	6 (5)	0.95 (0.31, 2.89)	.931
Generalized Anxiety Disorder	4 (3)	4 (4)	0.75 (0.18, 3.13)	.696
Enuresis	28 (20)	12 (11)	2.05 (0.98, 4.28)	.057
Encopresis	6 (4)	3 (3)	1.58 (0.38, 6.58)	.531
Child Behavior Checklist (CBCL), DSM-Oriented Syndromes, scaled scores $\geq$ 93rd percentile:				
Affective Problems	9 (6)	5 (5)	1.34 (0.43, 4.15)	.618
Anxiety Problems	10 (7)	7 (6)	1.09 (0.39, 2.98)	.874
Somatic Problems	8 (6)	9 (8)	0.63 (0.23, 1.72)	.369
ADHD Problems	21 (15)	6 (5)	2.92 (1.11, 7.68)	.030
Oppositional Defiant Problems	11 (8)	5 (5)	1.68 (0.56, 5.01)	.356
Conduct Problems	15 (11)	8 (7)	1.35 (0.54, 3.41)	.521
Behavior Rating Inventory of Executive Function, Parent Form (BRIEF-parent), T-scores $\geq$ 65:				
Behavior Regulation Index	21 (15)	7 (6)	2.49 (1.00, 6.17)	.049
Inhibition (BR)	22 (15)	6 (5)	3.09 (1.20, 7.98)	.020
Shift (BR)	23 (16)	6 (5)	3.34 (1.30, 8.56)	.012
Emotional Control (BR)	11 (8)	5 (5)	1.76 (0.59, 5.30)	.313
Metacognition Index	13 (9)	5 (5)	2.13 (0.70, 6.46)	.180
Initiate (M)	13 (9)	5 (5)	2.04 (0.69, 6.06)	.200
Working Memory (M)	30 (21)	8 (7)	3.38 (1.46, 7.81)	.004*
Plan/Organize (M)	12 (9)	7 (6)	1.33 (0.49, 3.57)	.572
Organization of Materials (M)	7 (5)	6 (5)	0.89 (0.29, 2.75)	.845
Monitor (M)	21 (15)	2 (2)	9.24 (2.11, 40.36)	.003 ^{*c}

Abbreviations: EPT/ELBW = Extremely Preterm/Extremely Low Birth Weight; NBW = term-born Normal Birth Weight; ADHD = attention deficit/hyperactivity disorder; BR = BRIEF Behavior Regulation domain; M = BRIEF Metacognition domain.

^aParent data were not obtained from 6 EPT/ELBW children because they were too low functioning to be assessed (n=4) or parents failed to complete the assessments (n=2).

^bSyndromes with low frequencies (<5 for both groups combined) not included.

^cSignificant when excluding 19 EPT/ELBW children not attending regular classrooms.

* Adjusted $p < .01$.

Table 3

Rates of teacher-reported behavior disorders in the EPT/ELBW (n = 110 of 148) and NBW (n = 107 of 111) groups.^a

Behavior Disorder	EPT/ELBW Group No. (%)	NBW Group No. (%)	Adjusted Odds Ratio (95% CI)	p-value
Teacher's Rating Form (TRF), DSM-Oriented Syndromes, scaled scores $\geq 93^{\text{rd}}$ percentile:				
Affective Problems	8 (7)	5 (5)	1.39 (0.43, 4.52)	.580
Anxiety Problems	10 (9)	5 (5)	2.16 (0.70, 6.67)	.179
Somatic Problems	1 (1)	1 (1)	0.98 (0.06, 16.29)	.989
ADHD Combined	20 (19)	7 (7)	2.99 (1.19, 7.49)	.019
ADHD Inattentive	20 (19)	4 (4)	5.56 (1.80, 17.20)	.003 ^{*c}
ADHD Hyperactive/Impulsive	13 (12)	9 (9)	1.35 (0.54, 3.36)	.515
Oppositional Defiant Problems	10 (9)	6 (6)	1.56 (0.54, 4.54)	.412
Conduct Problem	11 (10)	5 (5)	2.01 (0.65, 6.18)	.224
Behavior Rating Inventory of Executive Function, Teacher Form (BRIEF-teacher), T-scores ≥ 65:				
Behavior Regulation Index	23 (21)	14 (13)	1.66 (0.79, 3.48)	.179
Inhibit (BR)	26 (24)	14 (13)	1.93 (0.94, 3.98)	.075
Shift (BR)	13 (12)	10 (9)	1.26 (0.52, 3.06)	.610
Emotional Control (BR)	25 (23)	16 (15)	1.57 (0.77, 3.18)	.210
Metacognition Index	40 (37)	10 (9)	5.48 (2.53, 11.87)	< .001 ^{*bc}
Initiate (M)	45 (41)	7 (7)	9.87 (4.14, 23.54)	< .001 ^{**bc}
Working Memory (M)	43 (39)	11 (10)	5.72 (2.67, 12.27)	< .001 ^{**bc}
Plan/Organize (M)	29 (27)	6 (6)	5.94 (2.31, 15.24)	< .001 ^{**bc}
Organization of Materials (M)	25 (23)	6 (6)	4.62 (1.78, 12.00)	.002 ^{**c}
Monitor (M)	36 (33)	13 (12)	3.35 (1.64, 6.83)	< .001 ^{**c}
School Social Behavior Scale (SSBS), scores in at-risk or high risk range:				
Social Competence Composite (SC)	21 (19)	4 (4)	5.99 (1.95, 18.44)	.002 ^b
Peer Relations (SC)	24 (22)	4 (4)	6.88 (2.28, 20.75)	< .001 ^{*b}
Self-Management/Compliance (SC)	12 (11)	6 (6)	1.95 (0.68, 5.63)	.216
Academic Behavior (SC)	28 (25)	2 (2)	18.03 (4.12, 78.94)	< .001 ^{*b}
Antisocial Behavior (AB)	12 (11)	8 (7)	1.39 (0.52, 3.71)	.510
Hostile/Irritable (AB)	12 (11)	8 (7)	1.37 (0.52, 3.60)	.523
Antisocial/Aggressive (AB)	11 (10)	8 (7)	1.16 (0.42, 3.20)	.780
Defiant/Disruptive (AB)	16 (15)	11 (10)	1.36 (0.57, 3.26)	.493

Abbreviations: EPT/ELBW = Extremely Preterm/Extremely Low Birth Weight; NBW = term-born Normal Birth Weight; ADHD = attention deficit/hyperactivity disorder; BR = BRIEF Behavior Regulation domain; M = BRIEF Metacognition domain.

^a Sample sizes for teacher data were reduced to 110 EPT/ELBW children and 107 NBW controls due to home schooling (3 EPT/ELBW), participation of the child in a full-time special education classroom (16 EPT/ELBW), school or teacher refusals (8 EPT/ELBW), and failure to complete the assessments (11 EPT/ELBW, 4 NBW).

^b Significant when excluding children with neurosensory disorders or low global cognitive ability (Brief Intelligence Assessment score <10th percentile).

^cSignificant when considering only children with both teacher and parent ratings (applies only for measures with comparable parent and teacher forms—i.e., TRF and BRIEF-teacher).

* Adjusted $p < .01$.

Significant differences ($p < .01$) between the EPT/ELBW ($n = 148$) and NBW ($n = 111$) groups in non-parametric comparisons of symptom counts and T-scores.^a

Table 4

Behavior Measure	EPT/ELBW Group	N	median	n	NBW Group	Median	Whitney U	Z	p-value
Children's Interview for Psychiatric Symptoms, Parent Form (P-ChIPS) Syndrome Severity Ratings:									
ADHD-Inattentive	142	2	111	0	5145.50	-5.00	<.001 ^{cd}		
Oppositional Defiant Disorder	142	2	111	0	5636.00	-4.11	<.001 ^{cd}		
Enuresis	142	1	111	0	6497.50	-2.61	.009 ^d		
Child Behavior Checklist (CBCL), DSM-Oriented Scale T-scores:									
ADHD Problems ^b	142	51	110	50	6372.50	-2.63	.008 ^e		
Teacher Report Form (TRF), DSM-Oriented Syndrome Scale T-scores:									
Affective Problems ^b	108	50	105	50	4530.50	-2.89	.004 ^{ce}		
ADHD Problems ^b	108	55	105	51	3889.00	-4.06	<.001 ^{ce}		
Behavior Rating Inventory of Executive Function, Parent Form (BRIEF-parent) T-scores:									
Working Memory (M)	143	53	111	48	6094.50	-3.18	.001 ^{de}		
Behavior Rating Inventory of Executive Function, Teacher Form (BRIEF-teacher) T-scores:									
Behavior Regulation Index (BR)	109	50	106	45	4386.50	-3.09	.002 ^{ce}		
Inhibit (BR)	110	51	106	45	4621.50	-2.66	.008		
Shift (BR)	109	48	106	43	4372.50	-3.20	.001 ^{ce}		
Metacognition Index (M)	109	60	106	45	2925.50	-6.27	<.001 ^{ce}		
Initiate (M)	110	62	106	45	2820.50	-6.59	<.001 ^{ce}		
Working Memory (M)	110	60	106	43	2705.00	-6.83	<.001 ^{ce}		
Plan/Organize (M)	109	56	106	44	3281.50	-5.51	<.001 ^{ce}		
Organization of Materials (M)	110	51	106	46	3927.50	-4.23	<.001 ^{ce}		
Monitor (M)	110	60	106	46	3575.00	-4.93	<.001 ^{ce}		
School Social Behavior Scales (SSBS-2) T-scores:									
Social Competence Composite (SC)	110	49	107	61	3001.50	-6.24	<.001 ^c		

Behavior Measure	EPT/ELBW Group		NBW Group		Mann-Whitney U	Z	p-value
	N	median	n	median			
Peer Relations (SC)	110	49	107	61	2870.50	-6.53	<.001 ^c
Self Management/Compliance (SC)	110	55	107	60	4482.00	-3.05	.002
Academic Behavior (SC)	110	48	107	60	2679.50	-6.95	<.001 ^c
Defiant/Disruptive (AB)	110	43	107	41	4699.50	-2.69	.007

Abbreviations: EPT/ELBW = Extremely Preterm/Extremely Low Birth Weight; NBW = term-born Normal Birth Weight; ADHD = attention deficit/hyperactivity disorder; BR = BRIEF Behavior Regulation domain; M = BRIEF Metacognition domain; SC = SSBS-2 Social Competence scale; AB = SSBS-2 Antisocial Behavior scale.

^aData were not obtained for some children due to EPT/ELBW children who were too low functioning to be assessed, school or teacher refusals, and the failure of some parents and teachers to complete the ratings. Teachers completed questionnaires for 110 EPT/ELBW children and 107 NBW controls.

^bThe medians are similar but the EPT/ELBW group had a higher percentage of T-scores >50 than the NBW group: 60% vs. 48% for CBCL ADHD Problems, 48% vs. 30% for TRF Affective Problems, and 77% vs. 51% for TRF ADHD Problems.

^cSignificant when excluding children with neurosensory disorders or low global cognitive ability (Brief Intelligence Assessment score <10th percentile).

^dSignificant when excluding 19 ETP/ELBW not attending regular classrooms.

^eSignificant when considering only children with both parent and teacher ratings (applies only to measures with comparable parent and teacher forms—i.e., CBCL, TRF, BRIEF-parent, and BRIEF-teacher).

Table 5

Executive function test deficits significantly associated ($p < .01$) with behavior disorders in the EPT/ELBW group.

Behavior Disorder	Executive Function Test Deficit ^a	Deficit present No. (%) ^b	Deficit Absent No. (%)	Adjusted OR (95% CI)
Children's Interview for Psychiatric Syndromes, Parent Form (P-ChIPS):				
ADHD Combined	SS Switching	17 (61)	24 (24)	4.64 (1.84, 11.68)
	Trails Inhibit	22 (51)	18 (21)	4.00 (1.65, 9.69)
ADHD Inattentive	SS Switching	14 (50)	11 (11)	8.74 (3.07, 24.88)
	Trails Inhibit	15 (35)	9 (11)	5.27 (1.81, 15.37)
	GNG	17 (33)	11 (13)	3.32 (1.34, 8.23)
Enuresis	SS Switching	11 (39)	14 (14)	4.35 (1.57, 12.06)
	Trails Inhibit	15 (35)	10 (12)	4.88 (1.69, 14.07)
Behavior Rating Inventory of Executive Function, Parent Form (BRIEF-parent):				
Behavior Regulation Index (BR)	SS Inhibit	11 (27)	6 (7)	4.86 (1.58, 14.99)
Emotional Control (BR)	SS Inhibit	7 (17)	2 (2)	11.38 (2.03, 63.68)
Working Memory (M)	SS Inhibit	15 (37)	10 (11)	4.38 (1.68, 11.42)
	SS Switching	12 (40)	13 (13)	4.00 (1.49, 10.71)
	Trails Inhibit	15 (33)	9 (11)	3.89 (1.39, 10.93)
	GNG	20 (38)	8 (9)	5.37 (2.06, 14.00)
Monitor (M)	SS Inhibit	10 (24)	7 (8)	4.85 (1.53, 15.31)
	GNG	13 (25)	7 (8)	4.23 (1.44, 12.38)
Behavior Rating Inventory of Executive Function, Teacher Form (BRIEF-teacher):				
Metacognition Index (M)	SS Switching	11 (65)	22 (26)	4.77 (1.55, 14.63)
	Trails Inhibit	18 (55)	14 (21)	4.25 (1.62, 11.17)
	GNG	22 (58)	16 (23)	3.97 (1.65, 9.59)
Initiate (M)	SS Inhibit	18 (62)	21 (28)	3.89 (1.54, 9.82)
	SS Switching	13 (72)	25 (30)	5.78 (1.83, 18.24)
	GNG	26 (67)	17 (25)	5.60 (2.29, 13.68)
Working Memory (M)	GNG	25 (64)	17 (25)	4.63 (1.87, 11.46)
Organization of Materials (M)	SS Switching	9 (50)	12 (14)	5.38 (1.72, 16.86)
	CPT	15 (37)	8 (12)	4.04 (1.47, 11.12)

Abbreviations: EPT/ELBW= extremely preterm/extremely low birth weight; OR (95% CI) = odds ratio (95% confidence interval) adjusting for sex, race, and socioeconomic status (SES); ADHD = attention deficit/hyperactivity disorder; SS = Shape School; GNG = Go No-Go condition, Test of Inhibition and Attention condition; CPT = Continuous Performance Test condition, Test of Inhibition and Attention; BR = BRIEF Behavior Regulation domain; M = BRIEF Metacognition domain.

^aDeficit is defined as score at <10th percentile for age on standardized tests or <10th percentile relative to performance of the term-born normal birth weight group for unstandardized tests.

^bThe "deficit present" column lists the number of children with the given behavioral problem who had the specified executive function deficit out of the total number of children with that deficit, whereas the "deficit absent" column lists the number of children with a behavioral problem who did not have the specified executive function deficit out of the total number of children without that deficit. The odds ratio reflects the increase in the odds of EPT/ELBW children having a behavior problem given that the specified executive function deficit is present compared to when it is absent.