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Behavioral and Socio-Emotional Competence Problems of Extremely Low Birth Weight Children

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Abstract

Objective—To examine behavioral and social-emotional problems in extremely low birth weight (ELBW) children and to assess factors associated with behavioral and social competency outcomes at 30 to 36 months adjusted age.

Study Design—A total of 696 ELBW (401–1000 g) children from the NICHD Neonatal Research Network were included. Behavioral and social-emotional problems were assessed using the Brief Infant-Toddler Social and Emotional Assessment (BITSEA) administered to parents. Unadjusted comparisons were performed between children with or without behavioral or social emotional problems. Logistic regression was used to examine factors associated with behavioral outcomes.

Results—Parents reported behavioral problems in 46.8%, deficits in social-emotional competence in 20.4% and having both behavioral and social-emotional competence problems in 15.4% of ELBW children. Characteristics associated with behavioral problems in logistic regression included female gender, lower household income and a Bayley PDI < 70. Deficits in social competence were associated with Bayley MDI and PDI scores < 70 and Hispanic or Other races compared with White non-Hispanic.

Conclusions—Half of the (51.9%) ELBW children showed behavioral or social-emotional competence problems at 30 months. Low socioeconomic status and low Bayley MDI and PDI scores were associated with behavioral and socio-emotional difficulties.

Keywords

Premature; Prematurity; Behavior; Socioemotional

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Introduction

Survival has improved for extremely low birth weight children (ELBW). This improvement has been accompanied by concerns about neurodevelopmental outcomes not only during early childhood but at school age and even adulthood.[1, 2] Many studies have reported an increase in incidence of cerebral palsy, hydrocephalus, blindness and other severe neurological problems in ELBW survivors.[3, 4] In addition, it has been recognized that ELBW children are at increased risk for cognitive and behavioral problems, even in the absence of detectable brain abnormalities by neuroimaging.[1] However, the actual incidence of behavioral problems in ELBW children is not very clear, and although some studies have found larger differences when compared to full-term children in some areas like inattention and externalizing or internalizing behavior, others have not found significant differences in these areas. Several explanations have been offered for these discrepancies, including high attrition, inadequate sample and poor selection groups.[2, 5–9]

Regarding the social competence of premature children, there have been reports of negative effects[10] while others have not found much difference when compared to full term children. Some reported that these deficits in social competence were present early in infancy but were no longer present later.[11]

Bhutta et al reported that premature children with neurological complications have difficulty getting along with their peers during school age.[7] Behavior problems including lower rates of development in social responsiveness and initiations with their mothers were apparent in preterm infants from early infancy. In addition, the group of children with the slowest social development had a higher incidence of neurological complications.[12, 13]

There are several factors that may contribute to the neurobehavioral and socio-emotional problems of ELBW children, including the vulnerability of the premature brain during critical periods of development,[14, 15] multiple medical problems,[16] as well as the home environment. In addition, the Infant Health and Development Program findings indicate that negative emotional temperament during infancy is linked with social and cognitive development outcomes in early childhood. Intervention was more beneficial on behavioral and cognitive development among infants who have a negative emotional temperament (were less responsive) at 12 months of age. This finding suggested a need for increased attention to child temperament in early intervention research.[17]

Despite the increasing recognition of the importance of early detection of behavioral and social-emotional problems and mandates for provision of intervention services for infants and toddlers with social-emotional and or behavioral problems,[18, 19] several barriers for mental health screening in pediatric offices exist.[20]

The primary objective of the current study is to examine the behavioral and social emotional functioning of a large sample of ELBW children using two measures of behavioral performance. In addition, we will identify perinatal, neurological and environmental factors associated with social and behavioral outcomes.

This study will contribute to the advancement of knowledge about social/emotional development of ELBW children. We hypothesized that a higher percentage of ELBW children will have behavioral and socio-emotional problems and that these will correlate with earlier neurological morbidities and other perinatal variables.

Methods

Sample

The study cohort consists of ELBW children enrolled in the Glutamine trial[20] and seen at 30 (30–36) months corrected age. Children were enrolled at birth if they had a birth weight between 401 and 1000 grams and were cared for in one of the 15 participating centers of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Neonatal Research Network (NRN) between October 1999 and August 2001. Children with major congenital anomalies and congenital nonbacterial infection were excluded. More details regarding this study have been described elsewhere.[21] There were 1433 children included in the original study, of whom 251 died during the study and 26 died after discharge. The follow-up rate was 67% (779/1156) at 30 months. Additional children were excluded because the parent did not complete the behavioral assessment (16), because the presence of exclusionary criteria (30), i.e. syndromes(13), blindness (6) or deafness (11), or because they presented for follow up at the age of 36 months or more (37) which made using the behavioral assessment results invalid . This paper reports on the behavioral problems and social-emotional competence of 696 children whose parents completed the 30 month old visit behavioral assessment.

Measurements

Data on Pregnancy and Delivery were prospectively obtained by trained study coordinators until 120 days after birth or hospital discharge. At 30 months adjusted age, an updated interim medical history, updated social and demographic information, and anthropometric measures (weight, height and head circumference) were obtained. Methods for these measures and for establishing inter-rater reliability on all assessments have been reported previously.[22] Children underwent a physical and neurologic examination including the administration of the modified Gross Motor Function Scale.[23] Evaluators were blind to the randomization status in the Glutamine trial and were certified with yearly updates by the NRN for the neurologic assessment.

Certified examiners administered the Bayley Scales of Infant Development-Revised II (BSID).[24] Mental Developmental Index (MDI) and Psychomotor Developmental Index (PDI) corrected for gestational age were derived. Children who obtained standard scores below 50 on the MDI or PDI or who could not be tested due to severe developmental delay or sensory impairment were assigned a score of 49. The scale used to assess behavioral problems as well as social-emotional competencies was the Brief Infant-Toddler Social and Emotional Screening (BITSEA).[25] The BITSEA was derived from the 169 item Infant-Toddler Social and Emotional Assessment (ITSEA), which includes measures of internalizing, externalizing, dysregulation and competence in three social indices: social relatedness, atypical behaviors, and maladaptive, which can be indicative of Autism

Spectrum Disorders or other psychopathology. The BITSEA has been studied previously in the USA[26,27] and in other countries including Turkey, Finland and Holland.[28–32] The BITSEA is a short questionnaire and easy to administer and has shown to be a valid instrument.[28, 31–32] The BITSEA is administered as a survey to primary caregivers of children ages 12 to 36 months. The BITSEA provides general Problem and Competence Total scores. Problem behaviors include behaviors of typical development that may become problematic (e.g. aggression, sadness, or fear) and abnormal behaviors such as those often seen in children with autism spectrum disorders (e.g. odd posturing or hand movements, flapping and self-injurious behaviors). If the child's problem total score is greater than or equal to the cut scores (as provided in the manual by age and gender) that reflects equal or greater than the 75th percentile for the problem total score then the score is in the Possible Problem range. For this study, scores were interpreted according to adjusted age. BITSEA Competence items address the areas of attention, compliance, mastery motivation, prosocial peer relations, empathy, imitation/play skills and social relatedness. Assessment of competencies is critical to the identification of children who are not meeting developmental expectations in the social-emotional domain. Failing the competence scale is set at or below the 15th percentile (if total competence scores is below or equal to a set score in the manual for age and gender). Good test re-test reliability has been demonstrated with intraclass correlations of 0.82 for the Problem Scale and 0.72 for the Competence Scale. It has been validated against the Child Behavior Checklist (CBCL) and has also been shown to correlate with parents' reports of parental worry, stress, and interference in family life. It is also a good predictor for behavioral problems a year later[25] and at school age.[26]

Analysis

Network data are collected at each center on standard forms and are compiled at RTI International. RTI assesses data completion and consistency. Data analysis was performed using SAS version 9.1 (SAS Institute, Cary, NC). Student's t tests and chi square tests were used for initial bivariate analyses. Logistic regression models were constructed to predict high behavioral problem scores and low socio-emotional competence scores on the BITSEA. Neonatal variables screened for significance were gestational age at birth, birth weight, multiple birth, bronchopulmonary dysplasia (BPD), (defined as requiring oxygen at 36 weeks postmenstrual age, discharge or transfer, whichever came first), intraventricular hemorrhages (IVH) grades 3 or 4, periventricular leukomalacia (PVL), gender, and race. Variables from the 30 month exam included any cerebral palsy (CP) diagnosis, and MDI or PDI of less than 70. Other variables were maternal marital status, education, and age, Medicaid and household income.

Results

Parents of 326 (46.8%) children reported behavioral problems using the BITSEA and 142 (20.4%) reported problems with social competence at the 30-month age visit. In addition parents of 107 (15.4%) children reported both behavioral problems and social competence problems.

Mean behavioral and competence scores by gender are shown in Table 1. Males had significantly higher behavioral scores and lower competence scores. In bivariate analysis we found that the following characteristics were associated with behavioral problems at a significance level of <0.05 (Table 2): race, lower household income, Medicaid insurance, mother with no high school education, unmarried mother, younger mother, abnormal neurologic exam at 30 months, and Bayley MDI or PDI less than 70 at 30 months.

Regarding socio emotional competencies, we found that the following characteristics were associated with deficit/delay in socio-emotional competencies at a significance level of <0.05 in bivariate analysis: singleton birth, male gender, race, lower household income, receiving Medicaid, mother not completing high school, mother unmarried, presence of IVH grade 3 or 4, rehospitalization after discharge, CP at 30 months, abnormal neurologic exam at 30 months, and having a Bayley MDI or PDI less than 70 at 30 months.

Using logistic regression (Table 3) and holding other variables constant we found that factors associated with behavioral problems included being female, having a household income less than $50,000 per year and having a PDI less than 70 at the 30 month visit.

Using logistic regression analysis (Table 3) and holding other variables constant we found that having delays/deficits in socio-emotional competencies in the BITSEA at 30 months was associated with being Hispanic or Other race compared with White non-Hispanic, having an abnormal neurological exam or MDI <70 or PDI <70 during the 30-month visit.

Discussion

A significant number of ELBW children in our sample (51.9%) had problem behaviors or competence problems reported by their parents using the BITSEA. The use of the NRN Glutamine study cohort provided a unique opportunity to study, in a large cohort, the presence of socio-emotional and behavioral problems in ELBW children and to assess factors associated with behavioral outcomes at 30 months adjusted age. An increased incidence of behavioral problems at school age among preterm infants has been described; [2, 6, 8] there are fewer studies in younger children and these have been done outside the United States.[33–36]

Environmental factors have been reported to be associated with behavioral problems in preterm children.[37] Although lower income was associated with increased behavioral problems in bivariate analysis, we did not find it to be associated with deficits in social competencies after controlling for other variables. In adjusted analysis, Hispanic ethnicity was associated with greater odds of deficit in social competencies. Although the BITSEA was presented in the primary language of the parent, it is possible that some cultural differences may explain these differences. In addition, the BITSEA has not been validated in Hispanic children. However, it is possible that other factors not well understood in the environment may explain some of these differences as well.[27,37] Hispanic ethnicity has been described previously by others as associated with behavioral problems in a low birth weight sample.[38]

It has been reported in long-term follow up studies that males have poorer neurodevelopmental outcomes and more behavioral problems[35] at school age. However in our sample, after controlling for other variables, females had greater odds of having behavioral problems than males. This could be explained by cutoff scores which are different for males and females for behavioral or competency problems on the BITSEA; we used the cutoff scores as provided by the manual.[39] It should be noted that we did look at the mean raw scores of the BITSEA by gender and males had higher raw scores on behavioral problems than females (mean 14.2± 8.3 vs. 12.7±7.2, $p<0.05$). However, other studies in premature children saw more internalizing problems in females,[36] at school age and even into adulthood.[40] In addition, a recent study found poorer competencies in very premature females as compared to males.[34] It may be possible that very premature females are more vulnerable to behavioral problems or parents may have different expectations when reporting behaviors.

The Mental Developmental Index of the Bayley as well as the psychomotor index was associated with deficits in social competencies. Previous research has shown that children with poorer cognitive abilities or neurologic abnormalities have more problems with social competencies as well as behavior problems. However we found that only the PDI of the Bayley was associated with more behavioral problems. Others have described the poor predictive power of the Bayley for long term neurodevelopmental outcome.[41]

Lower social competence scores in the BITSEA have been reported as being associated with Autism Spectrum Disorder (ASD). Sensitivity has been reported between 72 to 93% and specificity from 76% to 85% for detecting ASD.[28] Among the 696 children with the BITSEA at 30 months, 20.4% had lower competence scores. The BITSEA is only a screener and not specific for ASD. Confirmation of ASD diagnosis was not part of the study design. In order to have a better understanding of ASD, specific diagnostic tests should be used, such as the Autism Diagnostic Interview-Revised and the Autism Diagnostic Observation Schedule.

This study has several limitations. First, the BITSEA is completed by the parent, is therefore subject to perceptions of parents. Previous studies have reported that mothers with a depression history may report more problems in children, as well as have difficulty understanding the surveys. However, the survey was administered as an interview by a certified trained research nurse. Second, we did not have a term control group; however, this large population allowed us to look into some of the variables associated with behavioral problems in extremely premature children. Third, the BITSEA is only a screener for behavioral problems and not a full-scale behavioral assessment; however, correlation of the BITSEA to the ITSEA is very high. In addition the BITSEA has been tested in different population and has been proved to be valid and effective in the detection of early behavioral problems in preschool children. The norm-referenced population of the BITSEA did not include many ELBW children as they are included in this sample. Fourth, language development data was not available for all of the study population so we were not able to use this in our data analysis.

The ELBW population is at high risk for overall developmental and behavioral problems including social emotional development, and perhaps even autism.[42] With the increased recognition of autism spectrum disorders in the general population, it is likely that this population at risk for brain injury may have an increase incidence of some of the autism spectrum symptoms.[43] The early social-emotional development and early behavioral problems in ELBW children have a potential impact on future school performance and overall functional outcomes. The negative effects of prematurity and low birth weight on behavior can be reduced with educational, family and social support.[44] Early screening and identification of children with behavioral or socio emotional problems may allow for further diagnostic testing and study interventions which may improve outcome.

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Abbreviations

ASD	Autism Spectrum Disorder
BITSEA	Brief Infant-Toddler Social and Emotional Assessment
BRS	Behavior Rating Scales
BSID	Bayley Scales of Infant Development-Revised II
BPD	Bronchopulmonary Dysplasia
CP	Cerebral Palsy
CBCL	Child Behavior Checklist
ELBW	Extremely Low Birth Weight
ITSEA	Infant-Toddler Social and Emotional Assessment
IVH	Intraventricular Hemorrhages
MDI	Mental Developmental Index
NICHD	Eunice Kennedy Shriver National Institute of Child Health and Human Development
NRN	Neonatal Research Network
PDI	Psychomotor Developmental Index
PVL	Periventricular Leukomalacia

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Table 1

Mean and SD scores on the overall sample by gender

Scores	Males N=315	Females N=381	P-value	Total
BITSEA				
Competence Scores	17.0 (3.6)	18.4 (2.9)	<0.0001	17.8 (3.3)
Problem Scores	14.2 (8.3)	12.7 (7.2)	0.0125	13.4 (7.7)

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Table 2

Characteristics of the Study Group

	Behavioral Problems			Social-Emotional Competencies		
Characteristic	**Behavioral Problems ≥ 75th percentile**	**< 75th percentile**	***P* value**	**Possible/deficit delay ≤ 15th percentile**	**> 15th percentile**	**P-value**
N	326	370		142	554	
Gestational Age weeks, mean (SD)	26.4 (1.8)	26.7 (1.9)	0.1444	26.4 (2)	26.5 (1.8)	0.4985
Birth Weight in grams, mean (SD)	782.9 (132.9)	795.6 (125.4)	0.1968	778.1 (139.9)	792.6 (126.1)	0.2308
Multiple birth	63 (19.3%)	93 (25.1%)	0.0666	23 (16.2%)	133 (24%)	0.0465
Gender Male	136 (41.7%)	179 (48.4%)	0.0781	68 (47.9%)	247 (44.6%)	0.0097
Female	190 (58.3%)	191 (51.6%)		74 (52.1%)	307 (55.4%)	
Race:			<0.0001			<0.0001
Black Non-Hispanic	184 (56.4%)	132 (35.7%)		84 (59.2%)	232 (41.9%)	
White Non-Hispanic	98 (30.1%)	186 (50.3%)		32 (22.5%)	252 (45.5%)	
Hispanic	41 (12.6%)	41 (11.1%)		24 (16.9%)	58 (10.5%)	
Other	3 (0.9%)	11 (2.9%)		2 (1.4%)	12 (2.2%)	
Household Income			<0.0001			<0.0001
<10.000	94 (28.9%)	43 (11.6%)		46 (32.4%)	91 (16.4%)	
10,000–49,999	192 (58.9%)	187 (50.5%)		81 (57.0%)	298 (53.8%)	
≥ 50,000	40 (12.3%)	140 (37.8%)		15 (10.6%)	165 (29.8%)	
Medicaid	236 (72.4%)	171 (46.3%)	<0.0001	112 (78.9%)	295 (53.4%)	<0.0001
Mother completed HS education	212 (67.3%)	294 (79.9%)	0.0002	86 (62.8%)	420 (76.9%)	0.0007
Mean Maternal age (SD)	26.5 (6.8)	28.5 (6.6)	<0.0001	26.8 (6.7)	27.8 (6.8)	0.1086
Mother married	106 (32.5%)	217 (58.7%)	<0.0001	37 (26.1%)	286 (51.6%)	<0.0001
Bronchopulmonary Dysplasia	144 (44.2%)	179 (48.4%)	0.2668	68 (47.9%)	255 (46.0%)	0.692

	Behavioral Problems			Social-Emotional Competencies		
Characteristic	**Behavioral Problems ≥ 75th percentile**	**< 75th percentile**	***P* value**	**Possible/deficit delay ≤ 15th percentile**	**> 15th percentile**	**P-value**
IVH grade 3 or 4	31 (9.5%)	39 (10.6%)	0.6261	24 (16.9%)	46 (8.4%)	0.0026
Rehospitalization after discharge	180 (56.1%)	188 (50.8%)	0.1666	88 (62.4%)	280 (50.9%)	0.0146
Cerebral Palsy at 30 months	42 (12.9%)	32 (8.7%)	0.0699	30 (21.1%)	44 (8%)	<0.0001
Abnormal Neuro exam at 30 m	88 (27.2%)	67 (18.2%)	0.0048	58 (40.9%)	97 (17.6%)	<0.0001
Bayley MDI < 70 at 30m	86 (28.6%)	51 (14.9%)	<0.0001	57 (45.6%)	80 (15.4%)	<0.0001
Bayley PDI < 70 at 30 m	96 (34.7%)	60 (18.4%)	<0.0001	60 (52.6%)	96 (19.6%)	<0.0001

Table 3

Regression Models for Low Competence Scores and High Scores on Behavioral Problems at 30 months corrected age after controlling for other variables that included gestational age, birth weight, multiple births, IVH, Medicaid, maternal education, maternal marital status, maternal age, BPD, re-hospitalization, presence of CP and abnormal neurologic exam at 30 months of age.

Factors that were significant	**Low Competence Scores**	**P Value**	**High Behavioral Problem Scores**	**P Value**
	OR 95% CI		***OR 95% CI***	
Race Hispanic or Other *	2.53 (1.16, 5.51)	0.0194		
House hold income <10,000 10,000–49,999 (vs. 50,000+)			4.38 (2.06, 9.29) 2.80 (1.56, 5.02)	0.0001 0.0005
30 m Bayley MDI < 70	2.08 (1.14, 3.78)	0.0165		
30 m Bayley PDI <70	1.96 (1.06, 3.6)	0.0332	2.04 (1.20, 3.47)	0.0085
Female			1.60 (1.09, 2.34)	0.0165

* Compared to White non-Hispanic