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Developmental Outcomes of Extremely Preterm Infants with a Need for Child Protective Services Supervision

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Abstract

Objective—To evaluate neurodevelopmental outcomes of preterm infants with need for Child Protective Services (CPS) supervision at hospital discharge compared with those discharged without CPS supervision.

Study design—For infants born at <27 weeks of gestation between 2006 and 2013, prospectively collected maternal and neonatal characteristics and 18- to 26-month corrected age follow-up data were analyzed. Bayley-III cognitive and language scores of infants with discharge CPS supervision were compared with infants without CPS supervision using regression analysis while adjusting for potentially confounding variables, including entering CPS after discharge from the hospital.

Results—Of the 4517 preterm infants discharged between 2006 and 2013, 255 (5.6%) were discharged with a need for CPS supervision. Mothers of infants with CPS supervision were significantly more likely to be younger, single, and gravida ≥3; to have less than a high school education; and to have a singleton pregnancy and less likely to have received prenatal care or

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*A list of additional members of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Neonatal Research Network is available at www.jpeds.com (Appendix).

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Data statement

Data sharing statement available at www.jpeds.com.

antenatal steroids. Despite similar birth weight and medical morbidities, the CPS group had longer hospital stays compared with the non-CPS group. In adjusted analysis, cognitive scores were points lower (B = −1.94; 95% CI, −3.88 to −0.08; $P = .04$) in the CPS at discharge group compared with the non-CPS group. In children who entered CPS supervision after hospital discharge (an additional 106 infants), cognitive scores were 4 points lower ($\beta = -4.76$; 95% CI, −7.47 to −2.05; $P < .001$) and language scores were 5 points lower ($\beta = -4.93$; 95% CI, −8.00 to −1.86; $P = .002$).

Conclusion—Extremely preterm infants discharged from the hospital with CPS supervision or entering CPS postdischarge are at increased risk for cognitive delay at 2 years of age. Opportunities exist to intervene and potentially improve outcomes in this vulnerable group of children.

Child Protective Services (CPS) investigations increased by approximately 12% from 2013 to 2017.[1] Although rates vary, developmental delays have been reported in up to 40% of infants and 90% of toddlers involved in CPS.[2] Significant cognitive delays have been reported in nearly one-third of toddlers in the child welfare system.[3] Increased behavioral problems, including externalizing and dysregulation, have also been reported.[4]

Preterm infants are at risk for poor developmental and behavioral outcomes,[5–9] but most CPS cohorts do not distinguish between term and preterm status. A 1995 cross-sectional analysis of a California cohort reported that 36% of children entering foster care before 1 year of age were born preterm.[10] In a *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Neonatal Research Network (NRN) study of extremely preterm (EPT) infants born to adolescent mothers, CPS supervision was a predictor of low cognitive and language scores, although the subset of CPS infants was small.[11]

Given this scarcity of data, the additional impact of the need for CPS involvement in preterm infants already at high risk for developmental delay is unknown. The main objective of this study was to evaluate differences in cognitive, language, and behavior outcomes between children discharged from the hospital with the need for CPS supervision and those without the need for CPS supervision. Our primary hypothesis was that EPT infants with CPS supervision at discharge would have lower 2-year Bayley Scales of Infant and Toddler Development III (Bayley-III) cognitive and language scores compared with EPT infants without CPS supervision at discharge. A secondary hypothesis was that EPT infants with CPS supervision would have increased behavior/social problems, decreased competence on the Brief Infant Social and Emotional Assessment (BITSEA), and decreased growth outcomes at age 2 years. A post hoc analysis explored further relationships between changes in CPS status from discharge to 2 years of age and developmental delay measured by Bayley-III scores.

Methods

This was a retrospective cohort analysis of prospectively collected data (in the NICHD NRN generic database and follow-up database) by 21 NRN centers. Local Institutional Review Boards approved data collection. Infants born at <27 weeks of gestation between January

2006 and December 2013 at a participating NRN hospital and with a follow-up assessment completed at 2 years (defined as 18–26 months corrected age) were included. Infants with a major congenital anomaly or a syndrome associated with adverse developmental outcomes were excluded.

Two cohorts were evaluated: EPT infants who were discharged from the hospital with CPS supervision and those who were discharged without CPS supervision. CPS status was defined as any infant supervised as a ward of the court, in temporary custody by a state agency/court system and in the home of a relative (or other person), or mother and child together but supervised by state agency/court system. CPS status was recorded at hospital discharge and at a 2-year follow-up assessment.

Research personnel prospectively collected maternal data, including age, gravida status, race/ethnicity, education, prenatal care, and antenatal steroid use. Neonatal data included gestational age, growth measures (including z-scores),[12] sex, and morbidities, including but not limited to small for gestational age,[13] intraventricular hemorrhage (IVH) grade III-IV, cystic periventricular leukomalacia (cPVL), necrotizing enterocolitis (NEC), early-onset and late-onset sepsis, bronchopulmonary dysplasia (BPD), and severe retinopathy of prematurity (ROP).

At discharge and at 2-year follow-up assessment, living arrangement data collected included primary caretaker, household composition, education level, primary language, insurance status, and the number of places the child had lived between discharge and the 2-year assessment.

Certified examiners performed neurodevelopmental assessments at corrected age 18–22 months (for infants born between January 1, 2006 and June 30, 2012) or corrected age 22–26 months (for infants born between July 1, 2012, and December 31, 2013) secondary to a protocol change for assessment age.[14] The Bayley-III includes cognitive and language composite scores (mean, 100 ± 15); a score <85 represents 1 SD below the mean.[15] Bayley-III motor scores were not collected by the NICHD NRN until January 1, 2010, and are not included in the present analysis. The BITSEA, which captures socioemotional and behavioral information, was completed by the primary caregiver (for infants born between January 1, 2006, and May 30, 2012). This standardized, normative value-referenced behavioral screening instrument includes 2 scales: a Problem Scale (31 items), with higher scores reflecting increased behavior/social problems, and a Competence Scale (11 items), with lower scores reflecting less competence.[16]

The primary study outcomes were Bayley-III cognitive and language composite scores. Secondary outcomes were BITSEA Problem Scale score ≥75th percentile; BITSEA Competence score ≤15th percentile; moderate to severe cerebral palsy (CP), as demonstrated by an abnormal neurologic examination and Palisano Gross Motor Function Classification System level ≥2[17]; and growth measures (weight, length, and head circumference).

Statistical Analyses

Maternal, infant, and social characteristics and 2-year outcomes were compared between infants with CPS supervision (CPS group) and those without CPS supervision (non-CPS group) documented at initial hospital discharge. The χ^2 test was used for categorical variables and the *t* test or Wilcoxon rank-sum test was used for continuous variables, as appropriate. Bayley-III composite scores were calculated for corrected age. Unadjusted group comparisons were performed for the primary and secondary outcomes. Two separate generalized linear mixed models were used to evaluate the associations between CPS at discharge and cognitive and language scores. The unadjusted comparisons of outcomes for each factor accounted only for NRN center as a random effect (reflecting differences in population, clinical, and CPS practices).

Adjusted analysis controlled for center and other potentially confounding variables of the mother (ie, prenatal care, antenatal steroids, age, and nonwhite race), the infant (ie, gestational age, sex, BPD, NEC, early or late sepsis, IVH or cPVL, and severe ROP), the postdischarge home environment (ie, 2-year caregiver education of less than high school and non-English speaking, infant living in more than 1 home), and age at testing. Because some of the children entered CPS between discharge and 2 years of age, the final models included "CPS after discharge," because this potential confounder remained a significant factor in the adjusted model. The available sample provided at least 80% power for detecting a small difference (Cohen $d = 0.20$) between the CPS and non-CPS groups at discharge at a *P* value of .05 for the primary outcome. All *P* values were 2-tailed, with a value ≤.05 considered to indicate statistical significance. Analyses were conducted with SAS 9.4 (SAS Institute, Cary, North Carolina).

To explore the movement of children entering and exiting CPS over the 2-year period in more detail, an unadjusted post hoc analysis was performed for the primary outcomes (Bayley-III cognitive and language scores) and BITSEA scores for 4 subgroups of CPS exposure: (1) CPS at discharge only (child under CPS supervision at hospital discharge but no longer at 2 years), (2) CPS at 2 years only (child entered CPS supervision any time after initial hospital discharge),(3) child in CPS supervision at both discharge and until 2 years, and (4) child never in CPS. The overall *P* values for comparing all 4 groups were calculated, and pairwise comparisons between groups were performed only for outcomes with a significant overall *P* value.

Results

The study population included a total of 8995 EPT infants born at <27 weeks of gestation between January 1, 2006, and December 31, 2013, and admitted to a participating NRN center at ≤72 hours of age. Study cohort derivation is depicted in the Figure. There were no significant differences in rates of death, incomplete follow-up, or loss to follow-up between the CPS and non-CPS groups. The study cohort comprised 4517 EPT infants with available 2-year Bayley-III cognitive composite scores, of whom 255 (5.6%) were discharged from the neonatal intensive care unit (NICU) under CPS supervision.

Table I presents maternal and neonatal characteristics in the CPS and non-CPS groups at hospital discharge. Compared with mothers of infants in the non-CPS group, mothers of infants in the CPS group were more likely to be younger, single, of higher gravida, and less educated and to have a singleton pregnancy and less likely to have received prenatal care or antenatal steroids. Despite similar rates of sepsis, BPD, NEC, IVH, cPVL, and severe ROP in the 2 groups, the CPS group had longer NICU stays than the non-CPS group. At 36 weeks postmenstrual age, CPS infants were slightly heavier and had a larger head circumference.

Table II (available at www.jpeds.com) presents living arrangements at discharge and at 2 years. More than one-half (58%) of infants with CPS supervision were discharged to family, 36% were placed with a foster parent, and 2% were placed with an adoptive parent. At 2 years, the majority (62%) of infants with CPS supervision continued to have a family member as the primary caretaker, and the primary caretaker was more likely to be an English speaker compared with the non-CPS group. At both hospital discharge and 2 years, infants with CPS supervision were more likely to reside in larger households, to have lived in more than 1 home, and to have public insurance. Early intervention participation was similar in the 2 groups.

In unadjusted comparisons at 2 years (Table III), the CPS group had lower Bayley-III cognitive composite scores (mean, 85.3 ± 15.8 vs 88.6 ± 15.3; $P < .001$) and a greater proportion of scores <85 (39% vs 30%; $P = .003$). There were no significant between-group differences in Bayley-III language scores, BITSEA scores, or weight. The CPS group had a smaller head circumference, shorter length, and greater likelihood of moderate to severe CP and were more likely to have been rehospitalized.

Linear regression analysis adjusted for biological and social risks (Table IV) showed that CPS at discharge was independently associated with an almost 2-point lower Bayley-III cognitive score (−1.94; 95% CI, −3.80 to −0.08; $P = .04$), and that entering CPS after discharge was associated with almost 5-point lower cognitive and language scores (−4.76; 95% CI, −7.47 to −2.05; $P < .001$ and −4.93; 95% CI, −8.0 to −1.86; $P = .002$, respectively). Additional characteristics associated with lower Bayley-III scores included single mother, nonwhite race, and less than high school education of the 2-year primary caretaker. Male sex and major neonatal morbidities were identified as independent risk factors for lower cognitive and language scores.

Exploratory comparisons among CPS subgroups and infants never exposed to CPS are presented in Table V. Cognitive and language composite scores were lowest for infants who at 2 years either remained in CPS since discharge or entered CPS sometime after discharge. Compared with infants under CPS supervision at discharge only, the subgroup of infants under CPS supervision at both discharge and 2 years was more likely to have cognitive scores <85 (51% vs 32%; $P = .004$) and language scores <70 (29% vs 18%; $P = .04$). Infants who had never been under CPS supervision had the highest mean cognitive and language scores. In addition, mean BITSEA competency scores were lower for infants with CPS supervision at discharge and 2 years compared with those who had never been under CPS supervision (15.5 ± 4.6 vs16.6 ± 3.6: $P = .017$), although mean behavior problem scores were similar in the 2 groups (data not shown).

Discussion

This study investigated differences in cognition and language and secondary outcomes of behavior and growth at 2 years of age among EPT infants with and without CPS involvement. Our findings support our primary hypothesis that infants discharged from the hospital with CPS supervision are more likely to have lower 2-year cognitive scores compared with infants discharged without CPS supervision. Language scores were similar in the 2 primary study groups, however.

The CPS group was characterized by a greater number of maternal social and environmental risk factors, including multigravida, single mother, public insurance, and less education, prenatal care, and antenatal steroids. It did not appear that more medically complex infants were placed into CPS care at NICU discharge, given that there was no difference in neonatal morbidities between the 2 groups. For those infants leaving the hospital under CPS supervision, the majority were living with biological parent(s) or family members at discharge and at 2 years of age. This preference toward kinship care aligns with the goals of stability and family preservation advocated by the Adoptions and Safe Family Act.[18]

Early cognitive assessments of children with CPS involvement, consisting of data analyzed from the 1999–2000 National Survey of Child and Adolescent Well-Being cohort, were published by Stahmer et al.[19] These authors reported that 30% of infants aged 0–2 years had cognitive scores >2 SD below the mean. In a California child welfare cohort, 35% of toddlers scored >1 SD below the mean on the Bayley-II Mental Developmental Index, and 30% scored >2 SD below the mean.[3] Although not specified, it is likely that both cohorts included children born prematurely. In our EPT cohort, 39% and 13% had Bayley-III cognitive scores >1 SD and >2 SD below the mean, respectively. Mean scores for Bayley-III have been reported to be higher than expected, and thus comparing Bayley-III and Bayley-II results is challenging; nonetheless, this suggests that our results may be underestimates of delays.[20,21]

Mean cognitive scores were 3 points lower for infants in the CPS group compared with the non-CPS group. Although many of the social risk factors necessitating CPS supervision are also risk factors for developmental delay, cognitive findings remained significant after statistical adjustment. Regression analysis also revealed potentially greater negative impacts on cognitive and language scores when entering CPS supervision after discharge. This could be an effect of timing and/or duration of exposure to environments that necessitate supervision. The additional lowering of cognitive and language scores for those infants with CPS involvement, even by 2–5 points, can be thought of as increasing the risk of special education needs for EPT infants, as reflected in their higher rate of cognitive composite scores <85.

There were no between-group differences in mean Bayley-III language scores; however, 22% of the CPS group had language scores <70, in contrast to data reported by Stahmer et al, in which approximately 10% of children with CPS supervision at 0–2 years of age had language assessment scores >2 SD below the mean.[19] It is unclear whether Stahmer et al included preterm infants in their analysis. Many infants in our cohort were tested at 18–22

months of corrected age, which may be too early to detect language delays in EPT children. The time spent in disruptive environments, particularly during critical periods of language development, may adversely affect skills. Because language delays may increase over time in children under CPS supervision,[19] close surveillance is warranted.

BITSEA scores were similar in our CPS and non-CPS groups; approximately one-third of all children had high problem or low competency scores, similar to rates of behavioral problems reported in other preterm cohorts.[9,22] This could be due to parental underreporting of problems due to perception biases or socially desirable responding,[23,24] or because prematurity is a stronger determinant of behavioral problems than environments prompting CPS oversight. However, behavioral difficulties among children in foster care are well documented, with a 3- to 4-fold increased odds of anxiety, depression, and attention/hyperactivity disorders compared with the general population.[25,26] Because preterm infants are at increased risk for similar behavioral problems over time, longitudinal mental health evaluation of the EPT children in CPS is warranted.[27,28]

Poor growth is common among EPT infants.[29] The CPS group had a larger head circumference at 36 weeks postmenstrual age, but at 2 years demonstrated a greater lag in head circumference, and length, compared with the non-CPS group. Whether this was due to environmental influence is unclear, given that multiple variables, including poverty, stress, inflammation, and nutritional deficiencies, may contribute to poor growth.[30,31] The CPS group had a higher percentage of infants with moderate to severe CP, which has been associated with delayed head growth,[32–34] which may partially explain some of the growth findings. Although there were no differences in IVH or cPVL between the 2 groups, other markers of brain injury, such as cerebellar and white matter injury,[35,36] which were not captured in the NRN database, may have been higher in the CPS group, leading to higher rates of motor impairment. In addition, the infants with CPS supervision were less likely to receive antenatal steroids, which has a protective effect against CP.[37]

Health care utilization for medically and socially vulnerable populations is an important consideration. For this EPT cohort, infants discharged under CPS supervision were in the hospital an average of 11 days longer than infants not under CPS supervision. Because neonatal morbidities were similar in the 2 groups, prolonged hospitalization may have been due to social factors, including decreased parent/caregiver visitation, or the complexities of caregiver identification/placement. Rehospitalization rates were also higher for infants under CPS supervision. Although public insurance has been associated with an increased rate of rehospitalization,[38] CPS-supervised families may encounter challenges when navigating the healthcare environment, resulting in lapses in preventative care or frequent provider changes that lead to escalation of health care needs or services. It is encouraging that early intervention, which provides support to both infant and caregiver, was comparable in the 2 groups.

In post hoc analysis, the proportions of children scoring >1 SD and > 2 SD below the mean for cognitive and language scores were highest for those in under CPS supervision from discharge to 2 years. One-third of the EPT infants discharged under CPS supervision remained under supervision at 2 years, and in this group, one-half had a mean cognitive

score <85. The effect of duration of exposure to environmental stressors on neurodevelopment remains controversial, owing to the complexity and timing of exposures and variations in living environments and caregiver skills.[39–42] The results of our exploratory analysis should be interpreted cautiously but nonetheless suggest the need for a detailed study of the support available to and adversities faced by EPT infants under CPS supervision.

In our analysis, CPS supervision is likely a proxy for an inadequate home environment. There are state-to-state differences in the details of CPS policy, referrals, and management, as described in the National Study of Child Protective Services Systems and Reform Efforts of State CPS Policy[43] and the state statutes database.[44] Factors prompting CPS referral in an NICU may include maternal substance abuse, adverse maternal mental health, previous custody loss, or other concerns for potential abuse, neglect, or endangerment. In EPT infants, a long NICU stay allows for identification of psychosocial risks and implementation of parental support as needed. After discharge, it may be more difficult to identify risk factors and provide support, thus increasing the infants' exposure to adverse environments. Risk factors necessitating CPS supervision may impact the quality of parenting,[45–47] a critical factor for optimizing outcomes. Responsive, structured, and independence-promoting parenting styles are associated with improved child cognition and behavior,[48,49] and CPS goals include child placement with caregivers who are able to provide such nurturing interactions.

Our study has several strengths and limitations. We evaluated prospectively collected neonatal and 2-year outcome data in a relatively large cohort of EPT newborns with CPS supervision. The NICHD NRN database, which includes a large and diverse population represented by 21 tertiary care centers throughout the US, allowed exploration of outcomes at a critical time point of 0–2 years of age. Limitations include a retrospective analysis and the absence of data capturing reasons for CPS supervision and maternal risk factors, such as drug/substance use, domestic violence, or mental illness. In addition, the study was not powered to evaluate differences among CPS subgroups. Generalizations about foster homes and kinship care cannot be made, because placement strategies vary and case workers face the challenge of securing a safe environment while minimizing the disruptions of removal.

EPT infants discharged to CPS are a highly vulnerable population and are at increased risk for cognitive delays. Environments necessitating either the continued need for CPS supervision at 2 years of age or the need to enter CPS after discharge appear to convey even greater risk for low cognitive and language skills. The combination of being born EPT, an identified need for CPS supervision, and exposure to multiple social and environmental risk factors should trigger close surveillance. More research is needed to identify potential interventions for caregivers and infants.

Appendix

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Glossary

Bayley III	Bayley Scales of Infant and Toddler Development II
BITSEA	Brief Infant Social and Emotional Assessment
BPD	Bronchopulmonary dysplasia
CP	Cerebral palsy
CPS	Child Protective Services
cPVL	Cystic periventricular leukomalacia
EPT	Extremely preterm
IVH	Intraventricular hemorrhage
NEC	Necrotizing enterocolitis
NICHD	*Eunice Kennedy Shriver* National Institute of Health Child Health and Human Development
NICU	Neonatal intensive care unit
NRN	Neonatal Research Network
ROP	Retinopathy of prematurity

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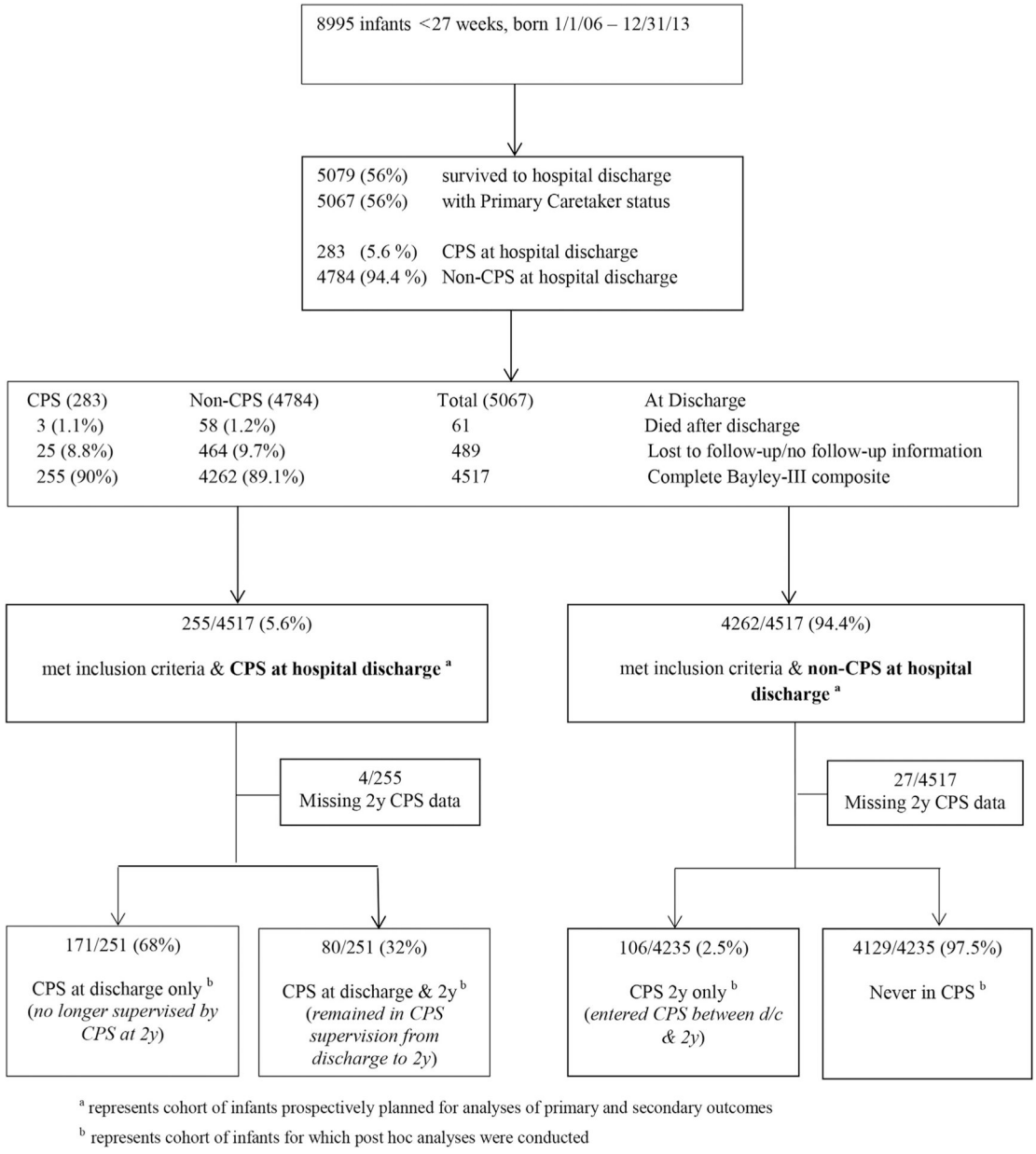

Figure.

Study flow chart. The cohort of infants prospectively planned for analyses of primary and secondary outcomes. The cohort of infants for which post hoc analyses were performed.

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Table I.

Maternal and neonatal characteristics

Characteristics	CPS group	Non-CPS group	*P* value
Maternal	N = 244 (5.9%)	N = 3877 (94.1 %)	
Age, y, mean ± SD	26.0 ± 6.7	27.5 ± 6.3	<.001
Gravidity, n (%)			
1	44 (18.0)	1237 (31.9)	<.001
2	49 (20.1)	950 (24.5)	.12
3+	151 (61.9)	1689 (43.6)	<.001
Singleton pregnancy, n (%)	217 (88.9)	3219 (83.0)	.02
Prenatal care (≥1 visit), n (%)	186 (76.2)	3730 (96.2)	<.001
Antenatal steroids, n (%)	190 (77.9)	3447 (88.9)	<.001
Highest grade completed, n (%)			
Less than high school graduate	81 (33.2)	674 (17.4)	<.001
High school graduate	44 (18.0)	868 (22.4)	.11
Some college	23 (9.4)	718 (18.5)	<.001
College graduate	10 (4.1)	667 (17.2)	<.001
Unknown	86 (35.2)	950 (24.5)	<.001
Race/ethnicity, n (%)			
White	97 (39.8)	1454 (37.5)	.48
African American	105 (43.0)	1597 (41.2)	.57
Hispanic/Latino	31 (12.7)	643 (16.6)	.11
Other	9 (3.6)	173 (4.4)	.57
Unknown	2 (0.8)	10 (0.3)	.11
Single, n (%)	203 (83.2)	2130 (54.9)	<.001
Neonatal	N = 255 (5.6%)	N = 4262 (94.4%)	
Male sex, n (%)	125 (49.0)	2115 (49.6)	.84
Birth weight, g, mean ± SD	774 ± 157	756 ± 154	.07
Birth length, cm, mean ± SD	32.5 ± 2.5	32.4 ± 2.5	.71
Birth head circumference, cm, mean ± SD	22.9 ± 1.7	22.8 ± 1.6	.30
Gestational age, wk, mean ± SD	25 ± 1	25 ± 1	.12

Characteristics	CPS group	Non-CPS group	*P* value
Postnatal steroids, n (%)	49 (19.2)	808 (18.8)	.96
Small for gestational age, n (%) *	12 (4.7)	219 (5.1)	.76
Early-onset sepsis, n (%) †	9 (3.5)	88 (2.1)	.12
Late-onset sepsis, n (%) ‡	75 (29.4)	1430 (33.6)	.17
NEC, n (%) §	26 (10.2)	403 (9.5)	.69
IVH ¶	43 (16.9)	655 (15.4)	.52
cPVL	16 (6.3)	235 (5.5)	.59
Severe ROP **	64 (25.1)	998 (23.4)	.54
BPD ††	142 (55.7)	2449 (57.5)	.59
Days of ventilation, mean ± SD	29 ± 29	30 ± 26	.71
Days in hospital, mean ± SD	127 ± 61	116 ± 45	<.001
Weight at 36 weeks PMA, g, mean ± SD	2116 ± 389	2064 ± 399	.06
z-score, mean ± SD	−1.2 ± 0.8	−1.3 ± 0.8	.04
Length at 36 weeks PMA, cm, mean ± SD	42.3 ± 3.0	42.0 ± 2.9	.22
z-score, mean ± SD	−1.8 ± 1.0	−1.9 ± 0.9	.16
Head circumference 36 weeks PMA, cm, mean ± SD	30.9 ± 2.0	30.5 ± 1.8	.01
z-score, mean ± SD	−1.1 ± 1.1	−1.3 ± 1.0	.01

PMA, postmenstrual age.

*Small for gestational age defined as <10% at birth as determined by the Alexander growth curve.[13]

†Early-onset sepsis defined as blood culture positive within first 3 days of life.

‡Late-onset sepsis defined as blood culture positive after day of life 3.

§NEC greater than or equal to Bell classification IIA.

¶IVH defined as grade III-IV.

**Severe ROP defined as greater than or equal to stage 3 and/or intervention.

††BPD defined as oxygen requirement at 36 weeks PMA.

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Table II.

Social and environmental characteristics at NICU discharge and at 2 years in EPT infants with or without CPS supervision at discharge

	At NICU discharge			At 2 years		
Characteristics	**Non-CPS (N = 4262; 94.4%)**	**Non-CPS (N = 4262; 94.4%)**	***P* value**	**CPS (N = 255; 5.6%)**	**Non-CPS (N = 4262; 94.4%)**	***P* value**
Primary caretaker, n (%)						
Kinship care	149 (58.4)	4226 (99.2)	<.001	159/251 (63.3)	4171/4236 (98.5)	<.001
Biological mother	107 (42.0)	4184 (98.2)	<.001	111 (44.2)	4041 (95.4)	<.001
Biological father	5 (2.0)	24 (0.6)	.006	13 (5.2)	63 (1.5)	<.001
Grandparent(s)	24 (9.4)	16 (0.3)	<.001	26 (10.4)	54 (1.3)	<.001
Other relative	13 (5.1)	2 (0.05)	<.001	9 (3.6)	13 (0.3)	<.001
Foster parent (nonkinship)	91 (35.7)	6 (0.1)	<.001	49 (19.5)	34 (0.8)	<.001
Adoptive parent	5 (2.0)	8 (0.2)	<.001	40 (15.9)	18 (0.4)	<.001
Other nonrelative/congregate care	7 (2.7)	3 (0.07)	<.001	2 (0.8)	10 (0.2)	.09
Still hospitalized	0	3 (0.07)	.67	1 (0.4)	3 (0.1)	.09
Primary caretaker married, n (%)	127 (49.8)	2071 (48.6)	.40	128/248 (51.6)	2168/4224 (51.3)	.90
Living/household arrangements, n (%)						
Single biological parent	54 (21.2)	1161 (27.2)	.04	61/250 (24.4)	1303 (30.8)	.03
2-parent biological	63 (24.7)	3048 (71.5)	<.001	70 (28.0)	2806 (66.3)	<.001
Grandparent(s)	16 (6.3)	19 (0.4)	<.001	21 (8.4)	43 (1.0)	<.001
Adoptive parent (relative)	2 (.8)	1 (0.5)	<.001	14 (5.6)	10 (0.2)	<.001
Adoptive parent (nonrelative)	1 (0.4)	4 (0.1)	.16	27 (10.8)	9 (0.2)	<.001
Preadoptive home	5 (2.0)	6 (0.1)	<.001	6 (2.4)	6 (0.1)	<.001
Foster family (relative)	12 (4.7)	0	<.001	2 (0.8)	6 (0.1)	.02
Foster family (nonrelative)	88 (34.5)	3 (0.1)	<.001	41 (16.4)	29 (0.7)	<.001
Other	11 (4.3)	12 (0.3)	<.001	8 (3.2)	18 (0.4)	<.001
Number of people in home, median (IQR)	4 (3–6)	4 (3–5)	<.001	5 (4–6)	4 (3–5)	<.001
Medical insurance, n (%)						
Public	214 (84.0)	2669 (62.6)	<.001	214/251 (85.3)	2669 (63.1)	<.001
Private	20 (7.8)	1063 (24.9)	<.001	20 (8.0)	1063 (25.1)	<.001
Uninsured	2 (0.8)	56 (1.3)	.47	2 (0.8)	56 (1.3)	.47
Both public and private	15 (5.9)	442 (10.4)	.02	15 (6.0)	442 (10.4)	.02

	At NICU discharge			At 2 years		
Characteristics	**Non-CPS (N = 4262; 94.4%)**	**Non-CPS (N = 4262; 94.4%)**	***P* value**	**CPS (N = 255; 5.6%)**	**Non-CPS (N = 4262; 94.4%)**	***P* value**
Highest grade completed of 2-y primary caretaker, n (%)						
Less than high school	n/a	n/a		52/251 (20.7)	682 (16.1)	.05
High school graduate	n/a	n/a		71 (28.2)	1180 (28.0)	.88
Some college	n/a	n/a		74 (29.5)	1179 (28.0)	.57
College graduate	n/a	n/a		49 (19.5)	1138 (26.9)	.01
Unknown	n/a	n/a		5 (2.0)	57 (1.3)	.39
Primary language in 2-y home, n (%)						
English	n/a	n/a		234/251 (93.2)	3649/4236 (86.1)	.001
Spanish	n/a	n/a		14 (5.6)	445 (10.5)	.01
Other	n/a	n/a		3 (1.2)	141 (3.3)	.06
Bilingual home in 2-y household, n (%)	n/a	n/a		48/251 (19.1)	1043/4233 (24.6)	.04
Places lived from discharge to 2 y, mean ± SD	n/a	n/a		1.8 ± 0.9	1.6 ± 0.8	.003
1, n (%)	n/a	n/a		114/248 (46.0)	2432/4192 (58.0)	.002
2, n (%)	n/a	n/a		97 (39.1)	1311 (31.2)	.009
3+, n (%)	n/a	n/a		37 (14.9)	449 (10.7)	.04
Receipt of early intervention at 2 y, n (%)	n/a	n/a		181/251 (72.1)	2848/4235 (67.2)	.11

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Table III.

Two-year outcomes of EPT infants with or without CPS supervision at NICU discharge

Outcomes	CPS (N = 255; 5.6%)	Non-CPS (N = 4262; 94.4%)	*P* value
Age at follow up, mo, mean ± SD	21.3 ± 3.1	21.3 ± 3.1	.79
Bayley-III			
Cognitive composite score, mean ± SD	85.3 ± 15.8	88.6 ± 15.3	<.001
Language composite score, mean ± SD	82.4 ± 16.5	83.9 ±17.1	.19
Expressive language score, mean ± SD	7.2 ± 2.8	7.5 ± 3.0	.13
Receptive language score, mean ± SD	7.2 ± 2.7	7.3 ± 2.9	.57
Cognitive composite <85, n/N (%)	97/252 (38.5)	1250/4224 (30.5)	.003
Language composite <85, n/N (%)	134/246 (54.5)	2070/4153 (50.0)	.16
Cognitive composite <70, n/N (%)	32/252 (12.7)	425/4224 (10.1)	.18
Language composite <70, n/N (%)	54/246 (22.0)	784/4153 (18.9)	.23
BITSEA			
Behavior problems total score, mean ± SD	12.7 ± 6.9	12.3 ± 7.2	.38
Competencies total score, mean ± SD	16.2 ± 4.1	16.6 ± 3.6	.13
Behavior problems ≥75%, n/N (%)	72/193 (37.3)	1076/3176 (33.9)	.33
Competency problems <15% n/N (%)	59/193 (30.6)	826/3113 (26.5)	.22
CP moderate-severe, n/N (%)	26/255 (10.2)	283/4259 (6.6)	.03
Weight, kg, mean ± SD	10.8 ± 1.4	10.9 ± 1.6	.24
Length, cm, mean ± SD	81.6 ± 5.0	82.2 ± 4.9	.04
Head circumference, cm, mean ± SD	46.3 ± 2.3	46.9 ± 2.2	<.001
Rehospitalization			
Hospitalized since discharge, n/N (%)	144/253 (56.9)	2052/4239 (48.4)	.007
Number of times, mean ± SD	2.5 ± 2.3	2.2 ± 2.0	.05

Table IV.

Unadjusted and adjusted linear regression of Bayley-III cognitive and language composite scores

	Bayley-III cognitive composite				Bayley-III language composite			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
Variables	**β coefficient (95% CI)**	***P* value**	**β coefficient (95% CI)**	***P* value**	**β coefficient (95% CI)**	***P* value**	**β coefficient (95% CI)**	***P* value**
Age at testing	−0.37 (−0.52 to −0.23)	<.001	−0.39 (−0.52 to −0.25)	<.001	−0.16 (−0.32 to 0.01)	.06	−0.16 (−0.32 to −.001)	.05
CPS at discharge	−2.97 (−4.90 to −1.04)	.003	−1.94 (−3.80 to −0.08)	.04	−1.12 (−3.29 to 1.06)	.31	−0.90 (−3.02 to 1.22)	.41
CPS entered after discharge	−5.02 (−7.97 to −2.07)	<.001	−4.76 (−7.47 to −2.05)	<.001	−4.71 (−8.01 to −1.41)	.005	−4.93 (−8.0 to −1.86)	.002
No prenatal care	−2.62 (−4.73 to −0.51)	.01	−1.67 (−3.71 to 0.37)	.11	0.05 (−2.33 to 2.44)	.96	1.05 (−1.28 to 3.39)	.38
No antenatal steroids	−2.1 (−3.53 to −0.68)	.003	0.11 (−1.27 to 1.49)	.88	−2.32 (−3.92 to −0.73)	.004	−0.05 (−1.62 to 1.52)	.95
Single mother	−2.58 (−3.48 to −1.68)	<.001	−1.19 (−2.18 to −0.20)	.02	−3.01 (−4.02 to −2.0)	<.001	−1.72 (−2.85 to −0.60)	.003
Maternal age	0.37 (0.02 to 0.72)	.04	−0.07 (−0.43 to 0.30)	.72	0.38 (−0.01 to 0.78)	.06	−0.11 (−0.52 to 0.31)	.62
Nonwhite	−3.69 (−4.61 to −2.77)	<.001	−3.17 (−4.17 to −2.18)	<.001	−5.47 (−6.50 to −4.40)	<.001	−4.44 (−5.57 to −3.31)	<.001
Less than high school education (2-y caregiver)	−3.31 (−4.48 to −2.14)	<.001	−1.91 (−3.11 to −0.71)	.002	−4.42 (−5.73 to −3.10)	<.001	−2.72 (−4.09 to −1.35)	<.001
Lived in more than 1 place since discharge	−0.73 (−1.64 to 0.17)	.11	−0.33 (−1.22 to 0.55)	.46	−0.36 (−1.38 to 0.66)	.48	0.0 (−1.00 to 1.01)	.99
Non-English speaker (2-y caregiver)	−1.96 (−3.27 to −0.66)	.003	−0.02 (−1.44 to 1.39)	.97	−5.16 (−6.63 to −3.70)	<.001	−2.78 (−4.40 to −1.16)	<.001
Gestational age	2.86 (2.43 to 3.30)	<.001	1.33 (0.88 to 1.77)	<.001	2.82 (2.33 to 3.31)	<.001	1.45 (0.94 to 1.95)	<.001
Male sex	−3.38 (−4.27 to −2.50)	<.001	−3.05 (−3.87 to −2.22)	<.001	−5.72 (−6.7 to −4.73)	<.001	−5.45 (−6.39 to −4.51)	<.001
BPD	−5.21 (−6.1 to −4.31)	<.001	−3.54 (−4.46 to −2.62)	<.001	−4.74 (−5.74 to −3.73)	<.001	−3.38 (−4.42 to −2.34)	<.001
NEC	−5.25 (−6.77 to −3.73)	<.001	−3.51 (−4.95 to −2.08)	<.001	−4.32 (−6.03 to −2.62)	<.001	−2.21 (−3.85 to −0.57)	.008
Early-onset sepsis	−2.93 (−6.0 to 0.15)	.06	−1.13 (−3.99 to 1.72)	.44	−0.26 (−3.73 to 3.21)	.88	0.63 (−2.65 to 3.91)	.71
Late-onset sepsis	−4.1 (−5.04 to −3.16)	<.001	−1.84 (−2.76 to −0.93)	<.001	−4.80 (−5.85 to −3.75)	<.001	−2.40 (−3.45 to −1.36)	<.001
cPVL or IVH (grade 3–4)	−7.83 (−8.98 to −6.67)	<.001	−6.58 (−7.69 to −5.47)	<.001	−5.77 (−7.08 to −4.47)	<.001	−4.45 (−5.72 to −3.19)	<.001
Severe ROP	−6.94 (−7.97 to −5.91)	<.001	−4.08 (−5.84 to −3.75)	<.001	−6.54 (−7.7 to −5.37)	<.001	−4.16 (−5.35 to −2.97)	<.001

Each variable included in the regression reflects statistically significant ($P \leq .05$) associations with the outcomes or prior data have shown associations with the outcome.

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Table V.

Two-year outcomes of EPT infants in CPS supervision subgroups

	CPS supervision				
Outcomes mean ± SD; n (%)	**CPS at discharge only (N = 171; 3.8%)**	**CPS at 2 y only (N = 106; 2.4%)**	**CPS at both discharge and 2 2 y (N = 80; 1.8%)**	**Never in CPS supervision (N = 4129; 92%)**	**Overall *P* value ***
Age at follow-up, mo, mean ± SD	21.6 ± 3.3	21.7 ± 3.3	20.5 ± 2.8	21.3 ± 3.1	.072
Bayley-III					
Cognitive composite score, mean ± SD	85.9 ± 14.5[a]	83.9 ± 15.3[b]	83.9 ± 18.4[c]	88.7 ± 15.3	<.001
Language composite score, mean ± SD	83.6 ± 16.0[d]	79.6 ± 18.2	80.2 ± 17.7	84.0 ± 17.0	.02
Cognitive composite <85, n/N (%)	55/170 (32)[e]	44/104 (42)[f]	40/78 (51)[g]	1198/4094 (29)	<.001
Language composite <85, n/N (%)	86/167 (53)	59/103 (57)	45/75 (60)	2000/4025 (50)	.14
Cognitive composite <70, n/N (%)	19/170 (11)	15/104 (14)	13/78 (17)	408/4094 (10)	.11
Language composite <70, n/N (%)	30/167 (18)[h]	28/103 (27)[i]	22/75 (29)[j]	751/4025 (19)	.02

*Overall *P* values indicate where there is an overall difference between variables. Localization of differences between subgroups is indicated by superscript letters.

[a]Discharge only vs never CPS (*P* = .02).

[b]2 y only vs never CPS (*P* = .001).

[c]Discharge and 2 y vs never CPS (*P* = .006).

[d]2 y only vs never CPS (*P* = .01).

[e]Discharge only vs discharge and 2 y (*P* = .004).

[f]2 y only vs never CPS (*P* = .004).

[g]Discharge and 2 y vs never CPS (*P* < .001).

[h]Discharge only vs discharge and 2 y (*P* = .04).

[i]2 y only vs never CPS (*P* = .004).

[j]Discharge and 2 y vs never CPS (*P* = .02).