Cognitive Delay and Behavior Problems Prior to School Age

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KEY WORDS

cognitive delay, behavior problems, early childhood, early intervention, longitudinal

ABBREVIATIONS

BSF-R—Bayley Short Form-Research Edition
BSID-II—Bayley Scales of Infant Development
CD—cognitive delay
ECLS-B—Early Childhood Longitudinal Study, Birth Cohort
EI—early intervention
ITSC—Infant/Toddler Symptom Checklist
NCES—National Center for Education Statistics
PKBS-2—Preschool and Kindergarten Behavior Scales—Second Edition
SES—socioeconomic status
TD—typically developing

Dr Cheng conceptualized and designed the study, conducted the analyses, and drafted the initial manuscript; Dr Palta assisted with the study design, helped interpret the data, and critically reviewed and revised the manuscript; Dr Kotelchuck critically reviewed and revised the manuscript and contributed to the interpretation of the data; Dr Poehlmann assisted with the study design and reviewed and revised the manuscript; Dr Witt assisted with the study design, acquisition of data, interpretation of data, drafting of the manuscript, and critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Children with cognitive delay have been shown to have more behavior problems than typically developing children; however, few studies have investigated this relationship over time or among very young children.

WHAT THIS STUDY ADDS: Our findings provide some of the first national, prospective evidence that having a cognitive delay may place children at risk for developing and maintaining behavior problems before school age. Early identification and intervention may improve outcomes for these children.

abstract

OBJECTIVE: To investigate the relationship between cognitive delay (CD) and behavior problems between ages 9 months and 5 years, while adjusting for covariates related to CD.

METHODS: Data were from 4 waves of the Early Childhood Longitudinal Study, Birth Cohort ($n = 8000$). Children were classified as typically developing (TD) or as having resolved, newly developed, or persistent CD between 9 and 24 months, based on scores from the Bayley Short Form-Research Edition below or above the 10th percentile. Child behavior was measured by using the Infant/Toddler Symptom Checklist (ages 9 and 24 months) and the Preschool and Kindergarten Behavior Scales (ages 4 and 5 years); children in the top 10th percentile were considered to have a behavior problem. Hierarchical linear modeling estimated the effect of CD status on children's behavioral trajectories, adjusted for confounders.

RESULTS: CD resolved for 80.3% of children between 9 and 24 months. Behavior problems at 24 months were detected in 19.3%, 21.8%, and 35.5% of children with resolved, newly developed, and persistent CD, respectively, versus 13.0% of TD children. Behavior problems increased among children with CD over time, and more so among children with persistent CD. By age 5, children with persistent CD had behavior scores moderately (0.59 SD) higher than TD children.

CONCLUSIONS: Behavior problems among children with CD are slightly higher at 9 months, clearly evident by 24 months, and increase as children move toward school age. Efforts to promote the earliest identification, evaluation, and service referral may be necessary to improve outcomes for these children. *Pediatrics* 2014;134:e749–e757

Mounting evidence demonstrates that children with cognitive delay (CD) are more likely to have psychosocial and behavioral problems than children without CD.^{1–16} Between 30% and 50% of children and adolescents with CD are estimated to develop mental health disorders, a risk nearly 3 times that of typically developing (TD) children.² Behavior problems with CD are associated with increased costs of care,⁹ social isolation,¹⁷ poor academic achievement,¹⁷ parental stress,⁷ and residential treatment placement.¹⁷

Despite these clinical and societal costs, there are critical gaps in our knowledge about behavior problems among children with CD. Few studies have evaluated very young children with CD, focusing instead on school-aged children and adolescents.² Moreover, existing data on very young children are drawn predominantly from convenience samples,^{7,8,10–13} limiting generalizability. We know of only 1 relevant study in a nationally representative sample. Emerson and Einfeld¹⁶ reported that 2- to 3-year-old children living in the UK and Australia with developmental delays had more behavioral difficulties than their TD peers. However, differences in social, environmental, and health care resources may preclude generalization of that study to US populations.

Additionally, studies have mostly been cross-sectional. To our knowledge, only 2 longitudinal studies evaluated behavior problems among very young children with CD and both were limited by short follow-up periods and the use of convenience samples.^{10,12,18} Baker et al^{7,10} reported more behavior problems in children with developmental delays than in those without delays between 36 and 48 months; by contrast, Feldman et al¹² reported no differences.¹⁸

The above studies leave important questions about the dynamics of behavior problems as children with CD age, especially as CD status may change.¹⁹ Recently, McManus and Rosenberg²⁰ found that young children with persistent develop-

mental delays were more likely to use early intervention (EI) services than children whose delays improved, emerged, or worsened. It is unknown whether such dynamics of early childhood CD also affect its association with behavioral development.

Using a large, national cohort of US children, we investigated the relationship between CD and behavior problems subsequent over a 3-year period in early childhood. We measured CD at 9 and 24 months, enabling us to examine how the onset and persistence of CD related to behavior problems. We hypothesized that children with indications of CD would have more behavior problems than their TD peers, with differences increasing with age. We also anticipated that the timing and persistence of CD would be associated with different behavioral trajectories.

METHODS

Data Source

Data were from 4 waves of the nationally representative Early Childhood Longitudinal Study, Birth Cohort (ECLS-B). The ECLS-B selected a probability sample of the ~4 million children born in 2001, with oversampling of minority groups, twins, and those born at low and very low birth weights, from births registered in the National Center for Health Statistics vital statistics system.²¹ The sampling frame excluded births to mothers younger than 15 years and children adopted or deceased before the initial collection wave.²² Data collection occurred between 2001 and 2006 when the children were ~9 months, 24 months, 4 years, and 5 years old.

Restricted data were obtained by approval from the US Department of Education, National Center for Education Statistics (NCES). Unweighted sample sizes were rounded to the nearest 50 to comply with NCES guidelines.²¹ The University of Wisconsin-Madison Health Sciences Institutional Review Board considered this study exempt from review.

From the original cohort of 10 700, we excluded cases where the (1) biological mother was not the survey respondent ($n = 150$), and (2) child did not complete the 9- and 24-month cognitive assessments ($n = 1800$). For each child sampled as a twin ($n = 1500$), we randomly selected 1 child from each pair to remain in the sample, leaving 8000 participants. Bivariate analyses found no statistically significant differences between participants in the original cohort and those in our sample (data not shown).

Measures

Cognitive Delay

CD was defined at ages 9 and 24 months by using the mental scale of the Bayley Short Form-Research Edition (BSF-R),²¹ a screening instrument comprising a subset of items from the revised Bayley Scales of Infant Development (BSID-II).²³ BSF-R items were selected from the BSID-II by using Item Response Theory modeling to approximate full BSID-II results and to facilitate comparisons of BSF-R and BSID-II scores. The ECLS-B data file included estimated BSID-II scores (predicted number of correct item responses), derived from the BSF-R. Item Response Theory reliability coefficients for the BSF-R mental scale were 0.81 and 0.88, respectively, at 9 and 24 months.²⁴ NCES converted raw scores to age-normed T-scores (mean = 50; SD = 10) by standardizing them relative to the weighted ECLS-B sample. For these scores, the age at administration for preterm children was recorded as chronological age adjusted for weeks preterm.

Consistent with previous research,^{25–27} we considered falling within the lowest 10th percentile of age-normed scores at either time point to indicate CD. Following Witt et al,²⁸ children were further classified as “ever” having CD and as having “resolved,” “newly developed,” or “persistent” CD.

Child Behavior

Child behavior was assessed by using modified versions of the Infant/Toddler

Symptom Checklist (ITSC)²⁹ and the Preschool and Kindergarten Behavior Scales–Second Edition (PKBS-2),³⁰ administered to mothers.

Seven items from the ITSC were administered during the 9- and 24-month interviews, asking how often the child (1) is fussy or irritable, (2) goes easily from a whimper to an intense cry, (3) demands attention and company (9 months) or is unable to wait for food or toys without crying or whining/falling apart (24 months), (4) wakes up more than 3 or more times in the night and is unable to go back to sleep (9 months) or is easily distractible or has fleeting attention (24 months), (5) needs a lot of help to fall asleep, (6) is startled by loud sounds (9 months) or tunes out from activity and is difficult to re-engage (24 months), and (7) cries for food or toys (9 months) or can't shift focus easily from one project or activity to another (24 months).^{21,31}

A 24-item version of the PKBS-2 was administered during the 4- and 5-year interviews. Principal-component analysis revealed that 9 items loaded on a single construct representing behavior problems. These items asked how often the child (1) was physically aggressive, (2) was angry, (3) was impulsive, (4) was overly active, (5) paid attention (reverse coded), (6) had temper tantrums, (7) had difficulty concentrating (age 4) or was unhappy (age 5), (8) annoyed other children, and (9) destroyed things.

We characterized behavior problems in 2 ways. First, as being above the top 10th percentile cut point, estimated as closely as the discreteness of scores allowed using the weighted distribution of ITSC or PKBS-2 scores at each age. Second, we summed responses to each of the items from the ITSC and the PKBS-2, creating a single variable with higher values indicating worse behavior. Scores were standardized (mean = 10; SD = 1) at each age.

Covariates

Birth certificates provided birth weight in grams (<1500 [very low]; 1500–2499

[low]; 2500–3999 [normal]; and ≥4000 [high]), plurality (singleton versus twin or triplet), and congenital anomaly diagnoses (ie, spina bifida or Down syndrome).

Covariates at 9 months included gender, race/ethnicity (non-Hispanic white; non-Hispanic black; non-Hispanic other race; or Hispanic), family structure (single versus 2-parent household), other children in the household (0, 1, or ≥2), and socioeconomic status (SES). SES was defined by using quintiles of a composite index generated by NCES incorporating caregiver education, labor force participation, and occupation.²¹ At 24 months, mothers reported their child's health insurance (none, only public, or any private), diagnoses of developmental delay or mental retardation, and EI service utilization.

Analyses

Analyses used SAS 9.2 (SAS Institute, Inc, Cary, NC). Descriptive statistics for risk factors and outcomes were weighted to account for unequal probability sampling. Differences in characteristics between children with CD ever and across CD subcategories (ie, resolved, newly developed, and persistent versus TD) were tested by weighted χ^2 statistics by using a jackknife procedure with replicate weights.

Hierarchical linear modeling³² via SAS PROC MIXED with continuous standardized behavior scores as outcomes was performed to examine change in behavior with age. Models were fit with random slopes and intercepts allowing correlation between individual-level random effects.³³ Fixed effects estimated average growth trajectories of child behavior over the study period, characterized by an intercept (ie, baseline behavior) and slope (ie, linear change in behavior with age). Through interaction effects, we evaluated the degree to which trajectories differed between children with ever CD and TD children and then across CD subcategories. The final models adjusted for covariates and their interactions with age. These analyses

were performed unweighted as a sensitivity analysis by using weighted generalized estimating equations yielded almost identical results.

Statistical significance of hierarchical linear modeling coefficients was tested by using robust SEs.³³ Coefficients represented predicted standardized mean differences in behavior scores for each variable relative to the reference group, reported as Cohen's *d* effect sizes in SD units.³⁴

RESULTS

Table 1 presents weighted descriptive statistics across the 5 CD groups (TD and ever, resolved, newly developed, and persistent CD). In the underlying population, 13.7% were estimated to meet our CD criterion at either 9 and/or 24 months of age. Children with ever CD were more likely than TD children to be boys, born at very low or low birth weights, a multiple birth, non-Hispanic black race or Hispanic ethnicity, low SES, publicly insured, have a congenital anomaly, and live in a single-parent household.

Approximately 20% of children with CD at 9 months remained with CD at 24 months, while 80% resolved. Children with resolved CD were the most likely to be girls, a multiple birth, and of high SES. Children with persistent CD were the most likely to be born at very low or low birth weights, have a congenital anomaly, be boys, non-Hispanic black, and live with a single parent or 2 or more siblings.

Approximately 85% of children with CD at 24 months had normal cognitive scores at 9 months. These children were the most likely to be born at high birth weights and be of Hispanic ethnicity. They were somewhat more likely to fall in the lowest 2 quintiles of SES than those with persistent delays and considerably more likely than those with resolved delays.

There was a strong gradient in diagnoses of developmental delay and/or mental retardation from 3.7% among TD children to 31.1% among children classified as

TABLE 1 Birth, Sociodemographic, Family, and Health Care Utilization Characteristics of Children by CD Status, National Estimates From the 2001 ECLS-B

	Total	CD Status, Ages 9 to 24 mo						Overall χ^2 <i>P</i>
		TD	Ever	<i>P</i> ^a	Resolved	Newly Developed	Persistent	
Total (unweighted)	8000	6550	1450		600	650	200	
Birth factors								
Birth weight status				<.0001				<.0001
Very low		0.8	3.3	***	5.2 ^b	1.4	7.0 ^b	***
Low		4.8	10.7	***	14.8 ^b	6.6	17.6 ^b	***
Normal		84.5	79.8	***	76.6 ^b	83.6	70.9 ^b	*
High		9.9	6.2	***	3.4 ^b	8.5	4.4	
Plurality status				<.0001				<.0001
Singleton birth		98.6	96.5		95.2 ^b	97.6	96.2 ^b	
Twin or triplet		1.4	3.5		4.8 ^b	2.4	3.8 ^b	
Congenital anomaly				.05				.03
Yes		1.2	2.0		3.1 ^b	0.8	3.5 ^b	
No		98.8	98.0		96.9 ^b	99.2	96.5 ^b	
Sociodemographic and family factors								
Child gender				<.0001				<.0001
Boy		49.5	62.4		52.8 ^b	66.9 ^b	76.1 ^b	
Girl		50.5	37.6		47.2 ^b	33.1 ^b	23.9 ^b	
Child race/ethnicity				<.0001				<.0001
Non-Hispanic white		55.7	41.3	***	53.4	32.8 ^b	40.5 ^b	***
Non-Hispanic black		13.0	17.8	***	16.1	18.6 ^b	20.6 ^b	**
Non-Hispanic other		7.1	8.2		7.8	8.2	10.2	
Hispanic		24.2	32.7	***	22.7	40.4 ^b	28.8	***
Child health insurance status				<.0001				<.0001
Private		61.3	49.4		38.4 ^b	43.9 ^b	55.4 ^b	***
Public		38.2	49.7	***	55.5 ^b	50.7 ^b	40.4 ^b	***
No insurance		0.5	0.8		6.1 ^b	5.4 ^b	4.2 ^b	
Family structure				<.0001				<.0001
Single-parent household		18.7	24.3		24.5 ^b	22.1 ^b	35.8 ^b	
Two-parent household		81.3	75.7		75.5 ^b	77.9 ^b	64.2 ^b	
Other children in the household				.28				.03
0		41.1	37.1		28.9 ^b	43.9	31.4	**
1		33.8	35.1		41.9 ^b	30.6	33.1 ^b	
2+		25.1	27.9		29.3 ^b	25.5	35.5 ^b	*
SES				<.0001				<.0001
First quintile (lowest)		19.0	25.2	***	22.6	26.8 ^b	26.2	*
Second quintile		19.0	26.2	***	19.6	30.7 ^b	27.1	***
Third quintile		20.3	18.9		16.6	20.8 ^b	17.5	***
Fourth quintile		21.0	15.4	***	21.2	10.5 ^b	19.6	***
Fifth quintile (highest)		20.7	14.4	***	19.9	11.2 ^b	9.6	***
Any EI services				<.0001				<.0001
Yes		2.9	11.4		9.3 ^b	10.6 ^b	24.2 ^b	
No		97.1	88.6		90.7 ^b	89.4 ^b	75.8 ^b	
Developmental delay diagnosis				<.0001				<.0001
Yes		3.7	14.1		9.5 ^b	14.4 ^b	31.1 ^b	
No		96.3	85.9		90.5 ^b	85.6 ^b	68.9 ^b	

Weighted estimates. Percentages may not sum to 100 due to rounding. Unweighted sample sizes were rounded to the nearest 50 in accordance with NCES guidelines. CD was defined by the lowest 10th percentile of the BSF-R mental scale at ages 9 and/or 24 mo, categorized as follows: resolved (CD detected at 9 mo but not at 24 mo); newly developed (CD detected at 24 mo but not at 9 mo); and persistent (CD detected at 9 and 24 mo); versus TD. *** $P \leq .0001$; ** $P \leq .01$; * $P \leq .05$ for difference between resolved, newly developed, and persistent CD status.

^a P value for difference comparing children with ever CD to TD children.

^b Values are statistically different from TD children ($P \leq .05$).

persistently delayed. EI services were used by 2.9% of TD children versus 24.2% of those with persistent CD.

Prevalence of Behavior Problems

Children with CD were more likely to have behavior problems at all ages than

TD children, and differences increased with age (Table 2). Mother-reported ITSC scores at 9 months exceeded the cut point for 13.0% of TD children versus 15.8% of children with CD ($P = .01$); by 24 months, the differential increased to 13.0% vs 22.1% ($P < .0001$). Overall

group differences were evident by 24 months, with behavior problems noted for 19.3%, 21.8%, and 35.5%, respectively, of children with resolved, newly developed, and persistent CD ($P < .0001$). Across all ages, children with persistent CD were most likely to have behavior

TABLE 2 Prevalence of Behavior Problems Among Children by CD Status, National Estimates From the 2001 ECLS-B

Child Behavior Problems, by Age	CD Status, Ages 9 to 24 mo						Overall χ^2 <i>P</i>
	TD, %	Ever, %	<i>P</i> ^a	Resolved, %	Newly Developed, %	Persistent, %	
9 mo (<i>n</i> = 8000)	13.0	15.8	.01	14.3 ^b	16.4 ^b	18.6 ^b	.11
24 mo (<i>n</i> = 8000)	13.0	22.1	<.0001	19.3 ^b	21.8 ^b	35.5 ^b	<.0001
4 y (<i>n</i> = 7250)	9.0	18.2	<.0001	13.3 ^b	20.8 ^b	24.1 ^b	<.0001
5 y (<i>n</i> = 5700)	7.5	13.6	<.0001	12.7 ^b	13.7 ^b	16.9 ^b	<.0001

Weighted estimates. Percentages may not sum to 100 due to rounding. Unweighted sample sizes were rounded to the nearest 50 in accordance with NCES guidelines. Child behavior problems were defined as falling in the top 10th percentile of ITSC (ages 9 and 24 mo) and PKBS-2 (ages 4 and 5 y) scores.

^a *P* value for difference comparing children with ever CD to TD children.

^b Indicates statistically significant difference from TD children (*P* ≤ .05).

problems. At 24 months and 4 years, children with newly developed CD were more likely to have behavior problems than children with resolved CD.

Longitudinal Results

Children with CD ever had slightly higher behavior scores at 9 months, but notably

higher behavior scores 24 months than TD children; they also showed significantly faster increases in behavior scores with age. By age 5, behavior scores among children with ever CD were 0.30 SD higher than TD children (Fig 1). These differences attenuated, but remained statistically significant after adjusting for

covariates (Table 3). The difference at 5 years was similar to that of children born at very low birth weights and those living in single-parent households, but less than that of being boy, of non-Hispanic black or other race, without insurance, or having low SES. Very low birth weight, male gender, race/ethnicity, single-parent

FIGURE 1

Unadjusted expected trajectories of child behavior by age among children with CD versus TD children, data from the 2001 ECLS-B. A, The unadjusted estimates of children's standardized behavior scores (y axis), by child age (x axis) for children with ever CD (eg, CD detected at either 9 and/or 24 months of age) and TD children. B, The unadjusted estimates of children's standardized behavior scores (y axis), by child age (x axis) for children with resolved, newly developed, and persistent CD and TD children. In both panels, the inset tables display the differences and SEs in behavior scores between children with and without CD, by child age. Each estimate in the table represents the standard difference in standardized behavior scores versus TD children, as displayed in the figure. Higher scores indicate worse behavior. All reported differences in the tables are statistically significant from TD children at *P* < .01.

household status, other children in the household, and lower SES predicted greater increases in behavior scores with age.

Behavior scores at 9 months were statistically significantly higher among children with resolved, newly developed, and persistent CD than TD children. By 24 months, the effect sizes (Cohen's *d*) for CD group differences ranged between 0.13 and 0.29, which are regarded as small effects.³⁴ Scores increased with age, especially for the newly developed and persistent CD groups (Fig 1). Children with persistent CD had behavior scores 0.59 SD greater than TD children by age 5. In the adjusted model (Table 4), the difference in the rate of change in behavior scores for the newly developed group was not statistically significant ($P = .06$). Persistent CD remained among the strongest predictors of initial levels and subsequent increases in behavior scores, and at age 5, children with persistent CD had adjusted behavior scores 0.39 SD higher than TD children.

DISCUSSION

We examined CD in early childhood and its relationship with subsequent behavior problems by using a large, national cohort of US children. Our results are important on several counts. First, our population-based data clarify that behavior problems among children with indications of CD are prevalent at very early ages. Across all preschool ages, children testing positive for CD by our criteria had worse behavior than their TD peers. This is consistent with previous clinic^{7,8,10–13} and nationally representative¹⁶ studies.

Second, adding to existing clinic-based work,^{10,12,18} behavior problems among children with CD increased significantly faster than among TD children, particularly between 24 months and 5 years of age. Importantly, our rich data set allowed us to examine behavior problems among young children with CD over multiple years and adjust for numerous

TABLE 3 Fully-Adjusted Model-Based Expected Trajectories of Child Behavior for Children With Ever CD Versus TD Children, Data From the 2001 ECLS-B

	Difference in Mean Child Behavior Scores ^a			<i>P</i> ^b
	24 mo, β (SE)	4 y, β (SE)	5 y, β (SE)	
CD status ^c				
Ever	0.12 (0.02)***	0.15 (0.02)***	0.17 (0.03)***	.05
TD	Reference	Reference	Reference	
Birth factors				
Birth weight status				
Very low	0.10 (0.03)***	0.19 (0.03)***	0.24 (0.04)***	<.001
Low	0.08 (0.03)**	0.08 (0.03)**	0.07 (0.04)*	.81
Normal	Reference	Reference	Reference	
High	0.10 (0.03)	0.02 (0.03)	0.03 (0.04)	.66
Plurality status				
Twin or triplet	0.01 (0.03)	0.03 (0.03)	0.04 (0.04)	.41
Singleton birth	Reference	Reference	Reference	
Congenital anomaly				
Yes	0.07 (0.06)	0.001 (0.06)	−0.03 (0.08)	.13
No	Reference	Reference	Reference	
Sociodemographic and family factors				
Child gender				
Boy	0.15 (0.02)***	0.31 (0.02)***	0.39 (0.02)***	<.0001
Girl	Reference	Reference	Reference	
Child race/ethnicity				
Non-Hispanic white	Reference	Reference	Reference	
Non-Hispanic black	0.14 (0.03)***	0.28 (0.04)***	0.35 (0.05)***	<.0001
Non-Hispanic other	0.09 (0.02)***	0.20 (0.03)***	0.25 (0.04)***	<.0001
Hispanic	−0.001 (0.02)	0.08 (0.03)*	0.12 (0.04)**	<.0001
Child health insurance status				
Private	Reference	Reference	Reference	
Public	0.03 (0.02)	0.02 (0.03)	0.02 (0.04)	.40
No insurance	0.33 (0.12)**	0.41 (0.17)*	0.44 (0.21)**	.61
Family structure				
Single-parent household	0.06 (0.02)*	0.11 (0.03)***	0.14 (0.03)***	.01
Two-parent household	Reference	Reference	Reference	
Other children in the household				
0	Reference	Reference	Reference	
1	0.01 (0.02)	0.10 (0.02)***	0.14 (0.03)***	<.0001
2+	−0.08 (0.02)***	0.04 (0.02)	0.10 (0.03)***	<.0001
SES				
First quintile (lowest)	0.27 (0.03)***	0.37 (0.03)***	0.42 (0.04)***	<.0001
Second quintile	0.17 (0.03)***	0.26 (0.03)***	0.30 (0.04)***	<.0001
Third quintile	0.10 (0.03)***	0.17 (0.03)***	0.21 (0.03)***	<.0001
Fourth quintile	0.06 (0.03)*	0.13 (0.03)***	0.16 (0.03)***	.001
Fifth quintile (highest)	Reference	Reference	Reference	
Between-person variability	0.35 (0.01)***			
Residual variance	0.53 (0.01)***			

*** $P \leq .0001$; ** $P \leq .01$; * $P \leq .05$.

^a Child behavior was measured by the ITSC (ages 9 and 24 mo) and the Preschool and Kindergarten Behavior Scales-2nd Edition (ages 4 and 5). Scores were summed and standardized to population; mean = 10, SD = 1. Higher scores indicate worse behavior. β coefficients represent the SD difference in behavior scores compared with the reference group.

^b P value for interaction with child age.

^c CD was defined by the lowest 10th percentile of the BSF-R mental scale at ages 9 and/or 24 mo, categorized as ever (CD detected at 9 mo and/or 24 mo) versus TD.

potential confounders, providing a more complete view of the developmental course of these problems than previously reported.

Third, CD status as measured changed considerably between 9 and 24 months. Although some changes may be due to

measurement error, especially leading to misclassification of borderline cases, the BSF-R has been reported to have high reliability.²⁴ Hence most of the changes, especially among children with newly developed CD, are likely real, highlighting an important period for interventions

TABLE 4 Fully-Adjusted Model-Based Expected Trajectories of Child Behavior for Children With Persistent, Newly Developed, and Resolved CD Versus TD Children, Data From the 2001 ECLS-B

	Mean Difference in Child Behavior Scores ^a			<i>p</i> ^b
	24 mo, β (SE)	4 y, β (SE)	5 y, β (SE)	
CD status ^c				
Resolved	0.07 (0.03)*	0.06 (0.03)	0.06 (0.04)	.80
Newly developed	0.15 (0.03)***	0.20 (0.04)***	0.22 (0.04)***	.06
Persistent	0.18 (0.06)**	0.32 (0.07)***	0.39 (0.09)***	.01
TD	Reference	Reference	Reference	
Birth factors				
Birth weight status				
Very low	0.11 (0.03)**	0.20 (0.03)***	0.25 (0.04)***	<.0001
Low	0.09 (0.03)**	0.08 (0.03)**	0.08 (0.04)*	.85
Normal	Reference	Reference	Reference	
High	0.01 (0.03)	0.02 (0.03)	0.03 (0.04)	.68
Plurality status				
Twin or triplet	0.01 (0.03)	0.03 (0.03)	0.07 (0.05)	.40
Singleton birth	Reference	Reference	Reference	
Congenital anomaly				
Yes	0.07 (0.06)	0.01 (0.06)	−0.03 (0.08)	.14
No	Reference	Reference	Reference	
Sociodemographic and family factors				
Child gender				
Boy	0.14 (0.02)***	0.31 (0.02)***	0.39 (0.03)***	<.0001
Girl	Reference	Reference	Reference	
Child race/ethnicity				
Non-Hispanic white	Reference	Reference	Reference	
Non-Hispanic black	0.13 (0.03)***	0.28 (0.04)***	0.35 (0.05)***	<.0001
Non-Hispanic other	0.09 (0.02)***	0.20 (0.03)***	0.25 (0.04)***	<.0001
Hispanic	−0.004 (0.02)	0.01 (0.03)*	0.12 (0.04)**	<.0001
Child health insurance status				
Private	Reference	Reference	Reference	
Public	0.03 (0.02)	0.02 (0.03)	0.02 (0.04)	.40
No insurance	0.33 (0.12)**	0.40 (0.17)*	0.44 (0.21)*	.64
Family structure				
Single-parent household	0.06 (0.02)*	0.12 (0.03)***	0.14 (0.03)***	.01
Two-parent household	Reference	Reference	Reference	
Other children in the household				
0	Reference	Reference	Reference	
1	0.01 (0.02)	0.10 (0.02)***	0.14 (0.03)***	<.0001
2+	−0.08 (0.02)***	0.04 (0.03)	0.10 (0.03)***	<.0001
SES				
First quintile (lowest)	0.27 (0.03)***	0.37 (0.03)***	0.42 (0.04)***	<.0001
Second quintile	0.17 (0.03)***	0.25 (0.03)***	0.29 (0.04)***	<.0001
Third quintile	0.10 (0.03)***	0.17 (0.03)***	0.20 (0.03)***	.001
Fourth quintile	0.06 (0.02)**	0.13 (0.02)***	0.16 (0.03)***	.001
Fifth quintile (highest)	Reference	Reference	Reference	
Between-person variability	0.32 (0.01)***			
Residual variance	0.53 (0.01)***			

****P* ≤ .0001; ***P* ≤ .01; **P* ≤ .05.^a Child behavior was measured by the ITSC (9 and 24 mo) and the Preschool and Kindergarten Behavior Scales-2nd Edition (ages 4 and 5). Scores were summed and standardized to population; mean = 10, SD = 1. Higher scores indicate worse behavior. β coefficients represent the SD difference in behavior scores compared with the reference group.^b *P* value for interaction with child age.^c CD was defined by the lowest 10th percentile of the BSF-R mental scale at ages 9 and/or 24 mo, categorized as follows: resolved (CD detected at 9 mo but not at 24 mo); newly developed (CD detected at 24 mo but not at 9 mo); and persistent (CD detected at 9 and 24 mo); versus TD. At each age, overall group differences were significant at *P* < .0001.

newly developing cases. There are limited data on the emergence, evolution, and resolution of childhood CD¹⁹; our findings suggest that understanding these dynamics may be critical to inform prevention and rehabilitation efforts.

Fourth, the development of behavior problems varied across the timing and persistence of CD. Persistently delayed children fared worst, both in terms of early behavior problems and subsequent changes with age. This may be related to the etiology of persistent CD, as specific syndromes associated with CD (eg, cerebral palsy or Down syndrome) have been associated with distinct phenotypic expressions and patterns of childhood behaviors.^{11,35,36} This group may also represent those with the most severe manifestations of CD and most accurate CD classification.

Low SES was associated with worse child behavior regardless of CD status. This aligns with previous research³⁷ and suggests that interventions to ameliorate children's behavior problems may need to consider the influence of low SES. Non-Hispanic black race and male gender also had equal or larger associations with behavior problems than CD. These children may be viewed as particularly important groups for monitoring, prevention, and intervention services. Although these variables had stronger estimated associations with behavior than CD, they were likely measured without error, while CD was identified via a screening instrument. More accurate diagnosis of CD may have led to higher associations.

Our data cannot prove that CD is causally related to behavior problems, because both seem to develop together from the earliest ages. It is notable, however, that behavior problems increased most rapidly with age in the group where CD was often due to problems present at birth. Regardless of the causal or temporal relationships, the high prevalence of behavior problems among young

aimed at reducing CD. Further, although over 85% of children with CD at 24 months displayed typical cognitive development at 9 months, 20% were

persistently delayed. Birth factors, including lower birth weights and congenital anomalies characterized persistently delayed children; this was not true for

children with CD points to the need to devise behavioral interventions for children with persistent or developing CD.

We were discouraged that only 11.4% of children identified as ever having CD received EI services. Consistent with McManus and Rosenberg,²⁰ EI service utilization was highest among children with persistent indications of CD; even so, <25% of these children received EI services by 24 months. Rosenberg et al³⁸ reported that only 10% of children in the ECLS-B who met criteria for Part C received EI services, and Witt et al³⁹ estimated that only 2 in 5 US children with disabilities and poor psychosocial adjustment receive mental health services. Further, developmental and behavioral disorders are underdiagnosed in primary care settings⁴⁰ with only half of pediatricians using recommended screening tools⁴¹ despite American Academy of Pediatrics guidelines.⁴² Together with our data, this reflects a gap in the need for and receipt of effective EI services. Strategies to increase developmental screening in pri-

mary care (eg, addressing reimbursement and time and personnel limitations),⁴³ simplifying application procedures,⁴⁴ and care coordination³⁹ may promote early identification and EI service use among children with CD; future research in these areas is warranted.

This study has limitations. First, our child behavior measure may be subject to recall bias. Second, in the absence of diagnostic criteria, we used a cutoff score on a one-time continuous measure to estimate the prevalence of behavior problems. The ECLS-B data set lacked information on the detection and treatment of children with CD, which may have influenced our findings. Further, our estimated prevalence and trajectory of behavior problems may be influenced by differential dropout rates. We also limited the scope of these analyses to associations with CD, as determined by a screening tool. Future research should examine more faceted classifications of CD, as well as other critical components of infant development, including early motor skills.

CONCLUSIONS

To date, the association between early CD and the development of behavior problems has not been adequately investigated in the United States. Although there have been cross-sectional^{17,8,16} and short-term follow-up studies,^{10,12,18} we believe ours is the first to examine this relationship across multiple years by using a national cohort of US children. Our findings establish, on a population-level, that disparities in behavior problems among children with CD originate at the earliest stages of life. We also found that the timing and persistence of CD influences children's psychosocial development. These findings support early identification, evaluation, and EI service referral for children with CD.

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