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The influence of children's cognitive delay and behavior problems on maternal depression

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Abstract

Objective—To determine the impact of children's cognitive delay and behavior on maternal depressive symptoms using a large, national cohort of US families.

Study design—Data were from two waves of the nationally-representative Early Childhood Longitudinal Study, Birth Cohort (n=7,550). Cognitive delay was defined at 24 months by the lowest 10th percentile of the Bayley Short Form-Research Edition. At age 4 years, child behavior was assessed by the Preschool and Kindergarten Behavior Scales, administered to mothers and primary non-parental child care providers, and maternal depressive symptoms with the Center for Epidemiologic Studies Depression Scale. Weighted generalized estimating equation models examined whether children's behavior mediated the relation between their cognitive delay status at 24 months and four-year maternal depressive outcomes.

Results—At age 4 years, 26.9% of mothers children with cognitive delay reported high depressive symptoms compared with 17.4% of mothers of typically developing children (p<. 0001). When children's behavior was accounted for, the effect of cognitive delay on maternal depressive symptoms decreased by 36% (p<.0001). Findings remained significant when children's behaviors were assessed by their primary non-parental care providers.

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The authors declare no conflicts of interest.

Conclusions—Caring for a child with a cognitive delay influences maternal depressive symptoms in part through children's behavior problems. Preventive interventions to ameliorate adverse outcomes for children with cognitive delay and their families should consider the impact of children's behavior.

Keywords

Maternal depression; developmental delay; behavior problems; early childhood

Caring for a child with a cognitive delay has a significant impact on parents, particularly in terms of psychosocial outcomes. Research has consistently demonstrated that mothers of children with cognitive and intellectual disabilities report lower levels of happiness, self-esteem and self-efficacy,[1] worse physical health,[2] impaired sleep,[3] and higher rates of depression,[4-6] anxiety,[6] mental health problems[7, 8] and stress[3, 9] than mothers of typically developing children. Such outcomes are likely associated with the excessive caretaking and financial burdens faced by these families.[6, 10-12] Another potential influencing factor is children's behavior problems. Children with cognitive delay are more likely to have mental health and behavioral problems than their typically developing peers,[13-16] with rates of comorbidity in children and adolescents ranging between 30 and 50%.[13]

Mental health problems among parents of children with cognitive delay and related developmental disabilities are more strongly associated with the children's behavior problems than with their disabilities per se.[17] Parents of children with intellectual disabilities and comorbid behavior problems report difficulty coping and with raising and managing their children. They are more likely to consider their children a heavy burden than do parents of children with intellectual disabilities without such behavior problems.[10] Further, the effect of children's behavior problems on maternal mental health has been shown to be stronger among families of children with cognitive delay than those of children without cognitive delay.[4] The relation has been well-studied using convenience samples of families of children and young adults with cognitive delay,[2, 8, 10, 18-22] but not among a representative or national sample of children with cognitive delay. Moreover, existing research on this topic has relied heavily on maternal reports.[3] It is possible that mothers' mental health may influence their judgments when reporting their child's behavior.

Therefore, the objective of this population-based cohort study was to determine whether children's behavior problems underlie the association between their early cognitive status and subsequent depressive symptoms in their mothers. This study advances the current knowledge base by using a representative national sample of US families and by including child behavior assessed from mothers as well as by children's primary non-parental care providers. We hypothesized that mothers of children with cognitive delay would be more likely to report high depressive symptoms than mothers of typically developing children and that children's behavior would contribute to this risk.

METHODS

Data were from the nationally-representative Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), a longitudinal cohort study of nearly 10,700 children born in 2001 and

their parents. The ECLS-B selected a probability sample of the approximately four million children born in 2001, with oversampling of minority groups, twins and those born at low and very low birthweights, from births registered in the National Center for Health Statistics vital statistics system.[23] The sampling frame excluded births to mothers under 15 years of age and children who were adopted or deceased before the initial collection wave. Parents of participating children in the ECLS-B provided informed consent and the data collection procedures were approved by National Center for Education Statistics (NCES) as ensuring confidentiality. We obtained a license agreement with NCES for analysis of ECLS-B's restricted data and report all unweighted sample sizes as rounded to the nearest 50 to comply with NCES guidelines.[23] The Partners Human Research Committee at the Massachusetts General Hospital for Children considered this study exempt from review.

Our data for this study is from children's birth certificates and two waves of data collection, which occurred when children were ~24 months and four years of age. Data were collected from direct developmental assessments of the children and from parents via interviews and self-administered questionnaires. During the four-year data collection wave, mothers were asked whether their child was receiving non-parental child care on a regular basis for 10 or more hours per week, and if so, to provide contact information for the care provider; these non-parental care provider were subsequently contacted by ECLS-B and interviewed.

Of the original cohort, approximately 8,900 children completed a cognitive assessment at 24 months. Our study sample included 7,550 of these children and their mothers with complete covariate data who remained in the ECLS-B for the four-year data collection wave. Information collected from the non-parental care provider was available for approximately 5,100 of these children.

Measures

Cognitive delay was defined at age 24 months using the mental scale of the Bayley Short Form-Research Edition (BSF-R),[23] a screening instrument that comprised a subset of items from the revised Bayley Scales of Infant Development (BSID-II).[24] BSF-R items were selected from the BSID-II using Item Response Theory (IRT) 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. The IRT reliability coefficient was 0.88.[25] The NCES converted raw scores to age-normed T-scores (mean=50, standard deviation [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 the number of weeks preterm. Consistent with previous research,[14, 26] we considered falling within the lowest 10^{th} percentile of these age-normed scores to indicate cognitive delay.

Maternal depressive symptoms were measured at child age four years using the 12-item Center for Epidemiologic Studies Depression Scale (CESD).[27] The self-administered CESD asked respondents to report the frequency of 12 events during the past week, such as "I felt lonely," and "I could not get going." Each item was coded on a Likert scale between 0 (never) and 3 (often). We combined responses to individual CESD items to create a raw symptom score (range 0-36) with higher scores representing more depressive symptoms. We

also used a cut point of >9 (comparable with a score of 16 or higher on the full CESD) to denote high depressive symptoms.[28]

Child behavior was assessed at age four by a modified version of the Preschool and Kindergarten Behavior Scales–Second Edition (PKBS-2),[29] completed by the child's mother and, if applicable, the child's primary non-parental care provider. The PKBS-2 is a standardized instrument designed to evaluate social skills and problem behaviors of children aged three to six years old. Respondents were asked to report the frequency of behaviors observed in the past three months. Items included how often (0=never to 4=very often) the child: (1) was physically aggressive; (2) was restless or fidgety; (3) acted impulsively; (4) was overly active; (5) paid attention well (reverse coded); (6) was angry/had temper tantrums; (7) had difficulty concentrating; (8) bothered or annoyed other children; and (9) destroyed things or disrupted others. A summary score (0-36) was calculated as the sum of the nine PKBS-2 items with higher scores indicating worse behavior (Cronbach's alpha=0.81). Scores were standardized to mean=10 and standard deviation (SD)=1.

Birth certificates provided the child's sex, birthweight, and plurality status (eg, singleton versus twin or triplet). Maternal demographic factors assessed at 24 months included age in years (15-19; 20-24; 25-29; 30-34; or over 35), race/ethnicity (non-Hispanic white; non-Hispanic black; non-Hispanic other race; or Hispanic/Latina), and marital status (married; never married; or divorced, separated or widowed). Family socioeconomic status (SES) at 24 months was defined by using a composite index (quintiles) generated by NCES that incorporated parental education, labor force participation, and occupation.[25] We categorized children's primary child care arrangement at age four into the following mutually-exclusive categories: parental care only; center-based care; Head Start; and home-based care (e.g., non-parental care in the child's own home or in another home).

Statistical analyses

Analyses were conducted using SAS 9.2 and used appropriate weights to account for ECLS-B's complex sampling design. Study variables were summarized using descriptive statistics; chi-square and t-tests were used to test for differences in cognitive delay status, mean CESD scores, and the prevalence of high depressive symptoms by child, maternal, and family factors.

Staged multiple linear regression analyses were conducted to evaluate the association between children's cognitive delay status at 24 months and maternal depressive symptoms at child age four years. Model 1 controlled for children's child care arrangement, sex, plurality and birthweight, maternal age, race/ethnicity and marital status, and family SES. The children's PKBS-2 scores (Model 2) were then added to Model 1 to test if they impacted the relation between cognitive delay status and maternal depressive symptoms. The relation between cognitive delay status and maternal CESD scores or high depressive symptoms was determined to be mediated by child behavior if the regression coefficient for cognitive delay was attenuated. The statistical significance of any mediating effects was formally tested using mediation package in R by Imai et al.[30] We additionally performed multiple logistic regression analyses using the dichotomized high depressive symptoms variable as the outcome. Finally models were rerun for the subsample of children receiving non-parental

child care using the care provider-reported PKBS-2 measure. All models were weighted and run using generalized estimating equations to account for clustering of twins within families.

RESULTS

Descriptive statistics by children's cognitive delay status are presented in Table I. In this national sample, 8.5% of children met our definition of having a cognitive delay at 24 months of age. Children with cognitive delay were more likely to be male, singleton births, and receive non-parental care than children without cognitive delay. By four years of age, over 80% of children received some type of non-parental child care, with the majority (45.8%) in center-based care. Mothers of children receiving non-parental care were older, of higher SES, and less likely to be depressed than mothers of children not receiving care (data not shown). Both mothers and non-parental care providers reported higher PKBS-2 scores for children with cognitive delay than for children without cognitive delay (Table I).

Table II presents associations of child, maternal, and family factors with maternal depressive symptoms. At child age four years, 18.5% of mothers reported high depressive symptoms. Mothers of children with cognitive delay were more likely to report high depressive symptoms than mothers of typically developing children (26.9% versus 17.7%, $p<.0001$). Children's cognitive delay status was also associated with higher CESD scores. There were statistically significant differences in mean CESD scores and high depressive symptoms by maternal and family characteristics, with the highest prevalence of high depressive symptoms found among teenage mothers, non-Hispanic black mothers, mothers who were divorced, separated or widowed, and those in the lower quintiles of SES.

In multivariable analyses predicting CESD scores (Table III), Model 1 revealed that mothers of children with cognitive delay at 24 months had higher CESD scores at child age four years than mothers of children without cognitive delay ($\beta=0.89$, $p=0.01$), controlling for child, maternal, and family characteristics. Adjustment for child behavior in Model 2 attenuated this relationship, such that the overall effect of cognitive delay status was no longer statistically significant ($p=0.16$). Mediation testing revealed that child behavior accounted for 36.3% of the effect of children's cognitive delay status on maternal CESD scores ($p_{mediation}<0.001$; data not shown). In Model 2, child behavior was positively associated with maternal CESD scores (β per SD increase in PKBS-2 scores=1.28, $p<.0001$).

These associations were similar when high depressive symptoms were used as the outcome. Mothers of children with cognitive delay at 24 months were more likely to report high depressive symptoms at child age four years than mothers of typically developing children (adjusted odds ratio [AOR] 1.55; 95% Confidence Interval [CI]: 1.19-2.03). Accounting for children's behavior (Model 2) reduced the effect of children's cognitive delay status on maternal high depressive symptoms by 13% (AOR from 1.55 to 1.35; 95% CI: 1.00-1.78, $p_{mediation}=0.02$). In this model, child behavior was independently associated with increased odds of high depressive symptoms (AOR 1.59; 95% CI: 1.45-1.73).

In the fully adjusted models, mothers who were divorced, separated or widowed, and who had lower quintiles of SES had higher CESD scores and were significantly more likely to

report high depressive symptoms than their counterparts. Mothers of male children and Hispanic/Latina mothers reported lower CESD scores, but no differences in high depressive symptoms.

Restricting the sample to families of children receiving non-parental child care (n=5,100) revealed similar associations among cognitive delay status, child behavior, and maternal depressive outcomes observed in the full sample (Table IV).

DISCUSSION

This nationally representative cohort study demonstrates that the relation between caring for a young child with a cognitive delay and maternal depressive symptoms may be partially explained by children's behavior problems. Our mediation model suggested that children's behavior accounted for approximately 36% of the effect of children's cognitive delay status on maternal depressive symptoms, independent of child, maternal, and family factors. This association was significant regardless of whether children's behaviors were reported by their mothers or by their non-parental care providers. Child behavior was a significant, independent predictor of maternal depressive symptoms in the adjusted model.

As hypothesized, mothers of young children with cognitive delay reported more depressive symptoms than mothers of typically developing children, with nearly 27% reporting high depressive symptoms at child age four. It is widely acknowledged that mothers of children with disabilities have worse health than mothers of typically developing children.[3-5, 12] Research demonstrates that increased care giving responsibilities,[6, 31] financial burdens,[32] and socioeconomic status[1, 9] may be key factors underlying this association. We focused on children's behavior because previous work identifies it as a predictor of parental mental health problems and stress.[31, 33] Behavior problems are more prevalent among young children with cognitive delay than among typically developing children,[14] making these families particularly vulnerable. Our findings align with previous studies implicating children's behavior as an important pathway though which their early developmental status may affect the mental health of their mothers.[2, 8, 10, 18-22] We believe our study is the first to note these relations in a national cohort of US families.

Multiple mechanisms may connect children's behavior to family-level outcomes. As discussed by McConnell,[34] children's behavior problems are likely a source of stress that disrupt family routines, challenge efforts to find suitable child care, and contribute to financial hardship, difficulties maintaining positive relationships and parental social isolation. Research demonstrates that among families of children with intellectual disabilities, parents whose children have accompanying behavior problems report a lower sense of parenting competence and less acceptance of and closeness with their children than parents of children without behavior problems,[35] which could negatively affect their mental health. It is also plausible that depressed mothers are more likely to recall their children's behavior negatively than non-depressed mothers, which may have biased our findings. However, our unique dataset allowed us to test this hypothesis using an independent measure of child behavior, a notable advance of previous research that has relied almost

exclusively on maternal report.[3] Our results were robust regardless of whether child behavior was reported by their mothers or by their non-parental care providers.

Our findings are important because child behavior problems are potentially modifiable characteristics that may be successfully managed through psychological and pharmacological interventions.[36] As behavior problems among children with cognitive delay appear to emerge in very early childhood,[14] an emphasis on early identification is justified and would have important implications for health services planning and intervention. Providers should also be aware that targeting early cognitive delay before behavior problems develop could have significant positive downstream impacts for the entire family. However, developmental and behavioral disorders are under-diagnosed in primary care settings[37] with only half of pediatricians using recommended screening tools[38] despite AAP guidelines.[39] This may contribute to the low proportion of eligible children who receive intervention services for their developmental needs.[40] Future research should identify effective strategies that increase developmental and behavioral screening in pediatric primary care and examine their effects on early identification and intervention use among young, at-risk children.

Although child-focused interventions are critical, targeting maternal depression directly may also improve outcomes in this population. Children, not families, are typically the focus of early intervention programs, but mothers of young children with cognitive delay are likely another group in need of services. Mindfulness and positive psychology interventions improve anxiety, depression, sleep and well-being among mothers of children with neurodevelopmental disabilities;[41] our findings suggest that programs like these designed for families of children with cognitive delay should consider the presence of behavior problems as a potential contributing factor. In terms of clinical practice, pediatricians are well positioned to provide consultation to parents of children with cognitive delay on methods to deal with their children's behavior problems, as well as conduct parental mental health screenings. Although not a part of routine pediatric care, there is support for integrating maternal mental health screenings into pediatric practice[42, 43] and addressing barriers to such screenings (e.g., lack of time, training and reimbursement)[44, 45] may help ensure that mothers are adequately screened and referred to services. Such efforts are important for women's health in its own right, but are also likely to mitigate the deleterious consequences of maternal depression[46, 47] to children's well-being and positively impact children's developmental progress. For example, parent training interventions among families of children with developmental disabilities have been shown to not only improve parental competence and satisfaction, but also to reduce negative child behaviors.[48] Finally, although we did not have information on paternal depressive symptoms, data suggest fathers of children with disabilities also have compromised well-being.[49] Efforts to improve outcomes for families of children with cognitive delay should therefore also consider paternal factors.

Strengths of this study include the use of a large, national cohort of US families and validated measures of child behavior and adult depressive symptoms. We tested our mediation hypothesis using a newer statistical technique and used an objective measure of child behavior administered to children's non-parental care providers that avoided limitations of previously published reports. We also note several limitations. First, we

measured maternal depressive symptoms and child behavior cross-sectionally and cannot demonstrate causal relations between these factors. There may have been differences in depressive symptoms between mothers of children with and without cognitive delay that preceded the onset of children's behavior problems, but the ECLS-B did not collect maternal CESD scores at 24-months so we could not test this hypothesis. Impacts of maternal depressive symptoms to children's behavior problems have been noted in the general population.[50] Further, although we focused on the effect of children's behavior on maternal depressive symptoms, future studies should examine the reciprocal or transactional relations between these dyads. Bidirectional effects of children's behavior on maternal depression and the effects of maternal depression on children's behavior seem likely and have been noted in studies of maternal stress and child behavior.[18, 51-53] Determining the extent to which these relations are mutually influential, mother-driven, child-driven, and impacted by cognitive delay offers a promising area for future research. Third, we used a global summary score to assess children's behavior and could not evaluate differential effects of specific types of behavior (e.g., aggression, impulsivity) on maternal depression. Fourth, the CESD items do not parallel diagnostic criteria used to identify depression in a clinical setting. The CESD also does not quantify the duration or frequency of depressive episodes or whether or not depressed mothers received treatment. Finally, children receiving non-parental care were different from children who received only parental care and thus our analyses of them may not be representative of all children.

In conclusion, our national findings suggest that behavior problems are an important, potentially modifiable pathway through which children's early cognitive status affects the mental health of their mothers. Monitoring both children's early cognitive ability and behavior may help identify children and families with the greatest need for early intervention services. Preventive interventions to ameliorate adverse outcomes for children with cognitive delay and their families should consider the impact of children's psychosocial development.

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Abbreviations

ECLS-B	Early Childhood Longitudinal Study, Birth Cohort
CESD	Center for Epidemiological Studies Depression Scale

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Table 1

Means, standard deviations, and frequencies for children by cognitive delay status at 24 months Cognitive Delay at 24 months

		Cognitive Delay at 24 months		
	Full Sample	**Yes**	**No**	p-value
N	7,550	750	6,800	
Weighted %	100	8.5	91.5	
Child Sex, %				<.0001
Male	50.7	67.6	48.8	
Female	49.3	32.4	51.2	
Mean Birthweight (grams), (SD)	3324.9	3187.3	3337.7	<.0001
	(736.8)	(783.7)	(709.8)	
Plurality, %				0.001
Singleton	96.7	95.4	96.8	
Twin or Triplet	3.3	4.6	3.2	
Child Care Arrangement at 4 years, %				0.003
Parental Care Only	19.8	16.1	20.2	
Center-based Care	45.8	45.8	45.8	
Head Start	12.1	17.4	11.6	
Home-based Care	22.2	20.8	22.4	
Mean PKBS-2 Score, 4 years (SD)				
Reported by Mother	12.4 (5.3)	14.4 (8.9)	12.2 (7.9)	<.0001
Reported by Child-care Provider (n=5,100)	10.2 (8.5)	13.6 (12.2)	9.9 (15.0)	<.0001

Notes. 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. Cognitive delay was defined at 24 months by the 10th percentile of the *Bayley Short Form-Research Edition* (BSF-R) mental scale.

Table 2

Sample characteristics and associations of child, maternal and family characteristics to maternal depressive symptoms at child age 4 CESD Scores

			CESD Scores		
	Full Sample, %	**Mean (SD)**	p-value[a]	**HDS, %**	p-value[a]
Full Sample	100	5.4 (5.7)		18.5	
Child Factors					
Cognitive Delay at 24 months			<.0001		<.0001
Yes	8.5	6.3 (10.2)		26.9	
No	91.5	5.1 (9.2)		17.7	
Maternal and Family Factors					
Maternal Age, years			<.0001		<.0001
15-19	3.4	7.2 (7.7)		32.6	
20-24	22.5	5.8 (9.3)		21.6	
25-29	25.3	5.5 (7.7)		20.8	
30-34	26.7	4.4 (8.8)		13.7	
35 or older	22.2	4.8 (7.4)		16.2	
Maternal Race/ethnicity			<.0001		<.0001
Non-Hispanic White	58.4	5.0 (8.4)		16.8	
Non-Hispanic Black	13.8	6.5 (9.8)		25.8	
Non-Hispanic Other Race	5.5	5.6 (10.8)		20.2	
Hispanic/Latina	22.3	4.8 (6.8)		17.8	
Marital Status			<.0001		<.0001
Married	69.1	4.6 (7.2)		15.4	
Never Married	24.2	6.2 (9.7)		24.0	
Divorced, Separated, or Widowed	6.7	7.1 (8.4)		29.8	
Family Socioeconomic Status			<.0001		<.0001
First Quintile (lowest)	19.2	6.8 (9.4)		28.6	
Second Quintile	19.8	5.7 (8.4)		21.8	
Third Quintile	20.4	5.4 (7.7)		19.7	
Fourth Quintile	20.1	4.2 (6.5)		11.4	
Fifth Quintile (highest)	20.5	3.9 (5.9)		11.4	

Notes. 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. Cognitive delay was defined at 24 months by the 10th percentile of the *Bayley Short Form-Research Edition* (BSF-R) mental scale. High depressive symptoms were defined by CESD score >9.

CESD – Center for Epidemiologic Studies Depression Scale; SD – standard deviation; HDS – high depressive symptoms.

[a]Chi-square p-value for overall group differences.

Table 3

Results from weighted multivariable analyses estimating maternal depressive symptoms at child age four from children's cognitive delay status and behavior scores

	Outcome = CESD Score Beta (SE)		Outcome = HDS OR (95% CI)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Child Factors				
Cognitive Delay Status, 24 months				
Yes	0.89 (0.36)**	0.50 (0.36)	1.55 (1.19-2.03)**	1.35 (1.00-1.78)*
No	Reference	Reference	Reference	Reference
Sex				
Male	−0.15 (0.17)	−0.60 (0.17)**	0.85 (0.72-1.00)	0.70 (0.59-0.83)***
Female	Reference	Reference	Reference	Reference
Plurality				
Singleton	0.27 (0.26)	0.38 (0.25)	1.04 (0.81-1.33)	1.09 (0.85-1.40)
Twin or Triplet	Reference	Reference	Reference	Reference
Child Care Type				
Parental-care only	Reference	Reference	Reference	Reference
Center-based	−0.72 (0.27)**	−0.62 (0.26)*	0.71 (0.57-0.89)**	0.73 (0.58-0.92)**
Head Start	−0.19 (0.37)	−0.15 (0.36)	0.94 (0.71-1.24)	0.94 (0.71-1.25)
Home-based	−0.30 (0.30)	−0.29 (0.29)	0.90 (0.70-1.14)	0.90 (0.70-1.15)
Maternal and Family Factors				
Maternal Age, years				
15-19	1.02 (0.62)	0.91 (0.56)	1.57 (1.03-2.38)*	1.53 (1.02-2.29)*
20-24	Reference	Reference	Reference	Reference
25-29	0.39 (0.29)	0.33 (0.28)	1.20 (0.95-1.52)	1.18 (0.93-1.50)
30-34	−0.15 (0.29)	−0.11 (0.28)	0.90 (0.69-1.17)	0.90 (0.69-1.18)
35 or older	0.38 (0.31)	0.46 (0.30)	1.16 (0.88-1.53)	1.21 (0.91-1.59)
Maternal Race/ethnicity				
Non-Hispanic White	Reference	Reference	Reference	Reference
Non-Hispanic Black	0.37 (0.28)	0.47 (0.28)	1.13 (0.89-1.44)	1.19 (0.93-1.52)
Non-Hispanic Other Race	0.39 (0.29)	0.42 (0.28)	1.14 (0.90-1.44)	1.15 (0.90-1.47)
Hispanic/Latina	−1.35 (0.25)***	−1.13 (0.25)***	0.69 (0.54-0.88)**	0.75 (0.59-0.95)*
Marital Status				
Married	Reference	Reference	Reference	Reference

	Outcome = CESD Score Beta (SE)		Outcome = HDS OR (95% CI)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Never Married	0.50 (0.29)	0.42 (0.28)	1.10 (0.87-1.40)	1.07 (0.84-1.37)
Divorced, Separated, or Widowed	1.67 (0.42)***	1.53 (0.41)***	1.67 (1.23-2.25)**	1.62 (1.20-2.19)**
Family Socioeconomic Status				
First Quintile (lowest)	2.49 (0.36)***	2.07 (0.35)***	2.54 (1.83-3.54)***	2.14 (1.53-3.00)***
Second Quintile	1.42 (0.31)***	1.13 (0.31)***	1.81 (1.32-2.48)***	1.60 (1.16-2.21)**
Third Quintile	1.25 (0.26)***	1.07 (0.25)***	1.66 (1.24-2.22)**	1.55 (1.16-2.08)**
Fourth Quintile	0.18 (0.22)	0.04 (0.22)	0.95 (0.70-1.28)	0.89 (0.66-1.20)
Fifth Quintile (highest)	Reference	Reference	Reference	Reference
Child Behavior Score, per SD		1.28 (0.10)***		1.65 (1.52-1.80)***

Models control for infant birthweight.

SE – standard error; OR – odds ratio; CI – confidence interval; HDS – high depressive symptoms defined by CESD score >9; CESD – Center for Epidemiologic Studies Depression Scale; SD – standard deviation.

* p<0.05;

** p<0.01;

*** p<0.001

Table 4

Results from weighted multivariable analyses estimating maternal depressive symptoms at child age four from children's cognitive delay status and behavior, as assessed by children's primary non-parental care providers (n=5,100)

	Outcome = CESD Score Beta (SE)		Outcome = HDS OR (95% CI)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Child Factors				
Cognitive Delay Status, 24 months				
Yes	0.98 (0.35)**	0.58 (0.35)	1.70 (1.27-2.28)***	1.46 (1.08-1.98)*
No	Reference	Reference	Reference	Reference
Sex				
Male	−0.07 (0.18)	−0.51 (0.18)**	0.90 (0.74-1.08)	0.73 (0.60-0.88)**
Female	Reference	Reference	Reference	Reference
Plurality				
Singleton	0.26 (0.28)	0.36 (0.27)	1.11 (0.84-1.46)	1.16 (0.88-1.54)
Twin or Triplet	Reference	Reference	Reference	Reference
Child Care Type				
Center-based	Reference	Reference	Reference	Reference
Head Start	0.49 (0.32)	0.41 (0.31)	1.29 (0.99-1.68)	1.24 (0.95-1.63)
Home-based	0.42 (0.21)*	0.32 (0.20)	1.26 (1.02-1.56)*	1.22 (0.98-1.51)
Maternal and Family Factors				
Maternal Age, years				
15-19	0.90 (0.65)	0.82 (0.58)	1.54 (0.97-2.45)	1.53 (0.97-2.42)
20-24	Reference	Reference	Reference	Reference
25-29	0.11 (0.30)	0.04 (0.29)	1.04 (0.79-1.36)	1.01 (0.76-1.33)
30-34	−0.36 (0.31)	−0.31 (0.29)	0.86 (0.64-1.16)	0.88 (0.65-1.18)
35 or older	0.10 (0.32)	0.19 (0.31)	0.98 (0.72-1.34)	1.03 (0.75-1.41)
Maternal Race/ethnicity				
Non-Hispanic White	Reference	Reference	Reference	Reference
Non-Hispanic Black	0.39 (0.30)	0.48 (0.29)	1.12 (0.85-1.46)	1.17 (0.88-1.54)
Non-Hispanic Other Race	0.22 (0.32)	0.23 (0.31)	1.03 (0.78-1.34)	1.02 (0.78-1.35)
Hispanic/Latina	−1.19 (0.27)***	−0.93 (0.27)***	0.71 (0.54-0.94)*	0.79 (0.60-1.04)
Marital Status				
Married	Reference	Reference	Reference	Reference
Never Married	0.17 (0.30)	0.16 (0.29)	1.01 (0.77-1.33)	1.01 (0.76-1.34)

	Outcome = CESD Score Beta (SE)		Outcome = HDS OR (95% CI)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Divorced, Separated, or Widowed	1.53 (0.43)**	1.38 (0.42)**	1.75 (1.25-2.45)**	1.69 (1.20-2.37)**
Family Socioeconomic Status				
First Quintile (lowest)	2.59 (0.39)***	2.17 (0.38)***	2.59 (1.79-3.76)***	2.17 (1.48-3.16)***
Second Quintile	1.26 (0.33)***	1.01 (0.33)**	1.66 (1.16-2.38)**	1.49 (1.03-2.15)*
Third Quintile	1.14 (0.27)***	0.98 (0.26)***	1.55 (1.13-2.13)**	1.46 (1.06-2.00)*
Fourth Quintile	0.08 (0.23)	−0.03 (0.22)	0.89 (0.64-1.23)	0.84 (0.61-1.17)
Fifth Quintile (highest)	Reference	Reference	Reference	Reference
Child Behavior Score, per SD		1.25 (0.10)***		1.66 (1.51-1.83)***

Sensitivity analyses performed only among children receiving non-parental childcare at four years of age. Models control for infant birthweight.

SE – standard error; OR – odds ratio; CI – confidence interval; HDS – high depressive symptoms defined by CESD score >9; CESD – Center for Epidemiologic Studies Depression Scale; SD – standard deviation.

* p<0.05;

** p<0.01;

*** p<0.001