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Effectiveness of Part C Early Intervention Physical, Occupational, and Speech Therapy Services for Preterm or Low Birth Weight Infants in Wisconsin, United States

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Abstract

Objective—To determine the effectiveness of policy-driven therapy (ie, Part C early intervention [EI]) in the context of varying maternal supports among preterm infants in Wisconsin.

Methods—A longitudinal study of mother–infant dyads recruited from 3 newborn intensive care units in southeastern Wisconsin. Participation in EI-based therapy was collected at 36 months via parent-report. Cognitive function was measured at 16 months by use of the Bayley Scales of Infant Development (Mental Developmental Index), 2nd edition and at 24 and 36 months postterm via use of the Stanford-Binet Intelligence scale, 5th edition. Maternal support was measured at 4 months with the Maternal Support Scale. Propensity score matching was used to reduce selection bias. Latent growth models of matched pairs estimated the effect of EI therapy on cognitive function trajectories. Ordinary least squares regression estimated the differential effect of EI therapy on cognitive function at 16, 24, and 36 months postterm for mothers reporting more maternal supports.

Results—Of the 128 infants, 41 received EI therapy and, of those, 32 (78%) were successfully matched with controls. The results of the matched analysis ($n = 64$) reveal that 1) receipt of therapy is inversely associated with cognitive function baseline ($P = .04$) and positively associated with trajectories ($P = .03$), 2) the number of maternal supports is positively associated with cognitive function for families receiving Part C early intervention, at 16 months ($P = .05$), 24 months ($P < .01$), and 36 months ($P = .05$) postterm.

Conclusions—Participation in EI therapy may be associated with more optimal cognitive function trajectories. Among preterm children whose mothers have more supports, receiving therapy appears particularly beneficial.

Keywords

cognitive function; part C early intervention; preterm birth

Introduction

In the United States, more than 1 in 10 infants are born preterm (<37 weeks) each year.¹ The long-term consequences of preterm birth are of public health concern and include neurodevelopmental difficulties such as poor cognitive function.^{2,3} To mitigate neurodevelopmental risk, many preterm infants receive therapeutic services. Receipt of therapy is efficacious in improving cognitive function among clinical samples of preterm infants.⁴ However, its effectiveness when programs are brought to scale in a policy-relevant context is less understood. The primary source of policy-governed therapy for preterm infants is Part C of the Individuals with Disabilities Education Act.⁵ Empirically testing the effect of Part C early intervention services (hereafter called early intervention) is complicated by variability in program characteristics and differences in observed and unobserved characteristics of children enrolled and not enrolled.

To mitigate methodological challenges, an analytic approach could restrict analyses to a relatively small geographical area (ie, to minimize state program differences), select a sample of infants with a specific diagnosis (eg, preterm birth), and use statistical methods to reduce child differences between treatment groups.

Although many preterm infants demonstrate later cognitive delays, there is tremendous variability in difficulties⁷ thought to stem from interactions between biological risk (eg, preterm birth) and protective factors (eg, family supports).^{8–11} Indeed, family supports are strongly correlated with infant cognitive function. To this end, it has been suggested¹¹ that early intervention services promote resilience by providing or bolstering existing family supports (eg, assistance with finances, information, child care or provision of emotional support), all of which may contribute to better infant cognitive function.¹¹ Thus, it is plausible that the effectiveness of early intervention services is modified in the face of varying maternal supports. Moreover, time points during the first 36 months postterm may exist in which the synergetic effects of early intervention therapy and quantity of maternal supports may prove particularly beneficial. To our knowledge, this has not been empirically tested. The purpose of this study is to examine 1) the effect of receiving early intervention therapy on infants' cognitive function trajectories, and 2) the differential effect at different time points (ie, 16, 24, and 36 months postterm) on cognitive function of early intervention therapy for children with greater levels of maternal support in a sample of preterm infants in southeastern Wisconsin, USA.

Understanding the effectiveness of early childhood policy governed programming is of particular importance during this time of financial crisis when many early-intervention programs may not be sustainable.¹² Moreover, identifying potentially modifiable resilience factors by which child policy-governed interventions might successfully promote preterm infants' developmental trajectories is critical for tailoring interventions for vulnerable families.

Methods

Sample

The study sample was derived from a larger longitudinal study (described previously¹³), which included 181 preterm (<37 weeks) and low birth weight (<2,500 grams) infants

hospitalized in 1 of 3 Wisconsin neonatal intensive care units from 2002 through 2005. Families were invited to participate in the study if: 1) infants were born at 35 weeks' gestation or less or weighed less than 2500 g at birth, 2) infants had no known congenital malformations or prenatal drug exposure, 3) mothers were at least 17 years of age, 4) mothers could read English, and 5) mothers self-identified as the infant's primary caregiver. Of the recruited 186 mother-infant pairs, 181 (97%) participated. Demographic characteristics of the study sample were generally comparable with the general Wisconsin population. For example, between 2002 and 2005, 25% of WI adults had a bachelor's degree compared with 31% of mothers in the study sample. During 2002 to 2005, between 10% and 14% of families lived in poverty compared with 19% of the study sample. Approximately 88% of families living in WI between 2002 and 2005 were white, non-Hispanic compared with 84% of the study sample. Caregivers participated in in-person interviews and infants were evaluated at the university developmental clinic (with the exception of hospital discharge) at 6 time points: before discharge from the neonatal intensive care unit, 4 months, 9 months, 16 months, 24 months, and 36 months postterm. There was a 17% attrition rate¹⁴ between hospital discharge and 36 months of age. Although this attrition rate is similar to previous studies¹⁵ with similar populations, mothers lost to follow-up were more likely to be of lower education and nonwhite. The present analysis is drawn from a subsample of 128 families who had complete data on the covariates of interest (described below in Predictors of Early Intervention Participation.). These 128 families did not differ significantly from the original 181 on postnatal depressive symptom scores, socio-demographic characteristics, or neonatal risk factors.

Outcome Measure

Children's cognitive function was measured at 3 time points: 16 months, 24 months, and 36 months postterm. At 16 months, the Bayley Scales of Infant Development, 2nd edition,¹⁶ Mental Developmental Index (MDI) was used. In the MDI, items are scored dichotomously (1 = able to complete or 0 = not able to complete) and summary scores are compared with a standardized distribution (mean = 100 and SD = 15). Appropriate for infants 1 to 42 months of age, the MDI has excellent reliability ($\alpha = .91$), average stability coefficients of at least .80 across age groups, and moderate-to-high concurrent validity ($r = .59-.79$).¹⁷ At 24 and 36 months corrected age, the Abbreviated Battery IQ scale (ABIQ) of the Stanford-Binet Intelligence Scale, 5th edition,¹⁸ was used to measure cognitive function. The Stanford-Binet is a widely used measure of cognitive function, appropriate for children older than the age of 2. A summary score is compared with a standardized distribution (mean = 100 and SD = 15). The ABIQ has excellent reliability ($\alpha = .95$ to $.98$) and moderate-to high concurrent and criterion validity.¹⁸ The age appropriateness of the cognitive function assessments in this study varied, which necessitated inclusion of different scales (ie, Bayley and ABIQ) across time to measure cognitive function. However, each is widely used in the child neurodevelopmental literature and the combined use of the Bayley and ABIQ is consistent with a large, randomized controlled study of preterm and low birthweight infants,¹⁶ which allows for comparability.

Measurement of Early Intervention Participation

We included a parent report measure of receipt of "any" early intervention services. At the 36-month interview, parents were asked whether their child received physical, occupational, or speech therapy services through early intervention at any time between birth and 36 months.

Predictors of Early Intervention Participation

In previous research,¹⁹⁻²¹ authors suggest mixed results with regard to the influence of family sociodemographic characteristics on early intervention participation. However, we

hypothesized that in this sample, lower family income and minority race may confer risk of early intervention access difficulties and we therefore include several measures reflecting infant and family sociodemographics. Child's race and ethnicity was categorized as white non-Hispanic or not (because of small numbers within minority subgroups). Yearly family income was collected in US\$. Maternal education was collected in years. We also included a measure of parity (primiparous versus multiparous), infant's sex, and whether the infant received public assistance. The positive association between more severe infant morbidity and receipt of early intervention services has been well established¹⁹ and we therefore included several measures to reflect neonatal health. Chronic lung disease was measured as whether the child was discharged from the newborn intensive care unit with supplemental oxygen (yes/no). Gestational age was measured in weeks. We also included a measure of length of newborn intensive care unit hospitalization (in days).

In a recent study,²² researchers suggested the importance of depressive symptoms on receipt of early intervention services. Maternal depressive symptoms were measured by use of the Center for Epidemiologic Studies Depression Scale (CES-D).²³ The CES-D asks mothers to report, on a 4-point scale (0 = rarely/none of the time to 3 = all of the time), their frequency of symptoms for 20 scale items. Scores of 16 or greater indicate clinically significant depressive symptoms. We chose the 4-month postterm measure of maternal depressive symptoms because other authors²⁴ suggests this might be a particularly sensitive period for maternal depressive symptoms among this population because mothers have had time to adjust to the non-normative experience of preterm birth (ie, the neonatal intensive care unit time point may capture short-term elevations). We also included a measure of presence (at hospital discharge) of a partner (married/cohabitating vs not married/not cohabitating).

To adjust for early differences in cognitive function, we included 9-month problem solving scores from the Ages and Stages Questionnaire–Third edition (ASQ-3).²⁵ The ASQ-3 is appropriate for children ages 1 month to 66 months and has sound psychometric properties.²⁶

Socioeconomic and neonatal morbidity characteristics were collected at hospital discharge. Maternal depressive symptoms (ie, CES-D) were collected at 4 months postterm.

Maternal Support

Maternal perceived social support was measured using the Maternal Support scale (Infant–Parent Interaction Lab. Maternal Support Scale. Madison, Wis: Waisman Center, University of Wisconsin; 2009: unpublished manuscript), an index of emotional, informational, household, child care, financial, respite, and other support, collected about the baby's father, mother's parents, in-laws, and extended family. A total perceived social support score was calculated by summing the scores of each type of support (7) across the four sources. Possible total scores range from 0 to 28. The maternal support scale has been shown to be a reliable and valid measure of the quantity of maternal supports. In terms of reliability, the internal consistency reliability of the index scores ranged from .73 to .87 for infants ranging in age from birth to 16 months postterm. Test-retest correlations for maternal report of support between the child's birth and 4, 9, 16, and 24 months ranged from .55 to .86.

With regard to its validity, the maternal support scale significantly correlated with the intimate relationship satisfaction and family satisfaction scales of the Social Support measure of Crnic, Greenberg, Ragozin, Robinson, and Basham's Inventory of Parent's Experiences²⁷ administered at 16 months (correlations ranged from .26 to .37, $P < .01$). Finally, the scale has been used to provide evidence in support of hypotheses that more maternal support buffers social and biological risk associated with health and neurodevelopmental outcomes,²⁸ thereby demonstrating its predictive and construct validity.

We used social support scores collected at 4 months, to test for effect modification of receipt of early intervention therapy on children's cognitive function by maternal perceived social support.

Analytic Approach

The analytic approach needed to account for the differences in sociodemographic and medical characteristics (ie, selection bias) of children who do and do not receive early intervention. The “gold standard”²⁹ for eliminating selection bias, randomized controlled trials, is less appropriate or feasible in the context of early intervention therapy because it would be unethical to deny a child with a disability services for which he is entitled. Therefore, policy analysts, economists, and epidemiologists use alternative methods such as propensity score matching to reduce selection bias and derive more rigorous estimates of the effect of a policy-relevant program on children's outcomes. Propensity score matching³⁰ is a methodologic technique that entails 1) calculating study infants' propensity to receive early intervention, 2) matching infants who do and do not receive early intervention based on propensity scores, and 3) conducting a series of matched analyses.

To calculate propensity to receive early intervention therapy, we used theory³¹ and previous empirical findings^{19,21,22} to build a logistic regression model to calculate propensity scores (ie, propensity for receiving EI) using the following variables: race, sex, chronic lung disease (yes/no), parity, presence of a partner, receipt of public assistance, cognitive function (9 months postterm), maternal education, gestational age, days hospitalized, family income, and maternal depressive symptoms. For model parsimony (ie, due to sample size of $n = 128$), a stepwise procedure was used, which yielded a logistic model with 2 significant predictors: gestational age and days hospitalized. This adjusted logistic regression model generated each infant's predicted probability or propensity for receiving early intervention. Using the predicted probabilities from the logistic regression model, we conducted matching procedures with the GREEDY macro³² in SAS.³³ The GREEDY macro uses a 1:1 matching procedure whereby differences in propensity scores of cases and controls are calculated and matched using an iterative process beginning with the a match to the 5th decimal place and proceeding to the 2nd decimal place until all possible matches are made. Once a control is matched, it is not a candidate for later matching.

To describe infant's cognitive function trajectories, we used latent growth models.³⁴ Latent growth curves model change over time that occurs within and between individuals, an advantage over autoregressive models that estimate the difference in outcome between specific time points. Latent growth models have a hierarchical structure in which the level-1 model describes individual children's trajectories and the level-2 model describes between-child differences in cognitive function trajectories. Trajectories are categorized by an intercept (ie, baseline cognitive function) and slope (ie, change over time in cognitive function). The intercept and slope are latent variables with a mean (ie, average trajectory in the sample) and variance (ie, heterogeneity of trajectories).

We first fit a quadratic model since our previous analyses²⁸ suggested that a quadratic specification fit the data best. However, as with the previous analyses, we had only 3 time points of data, which restricts our ability to fit a quadratic model where the intercept, slope, and quadratic are allowed to freely correlate with each other. Therefore, we constrained the variance between latent variables to equality across time points. Because the constrained quadratic model had superior fit and was theoretically sound, we focus our interpretation and subsequent modelbuilding based upon this well-fitting quadratic model.

In the latent growth models we present, both the slope (ie, linear trend) and quadratic term (ie, acceleration or deceleration of this trend) contribute to the trajectory and cannot be

interpreted in isolation. We present 3 measures of model fit—the comparative fit index, root mean square error of approximation, and standardized root mean square residual. Comparative fit index values greater than .95 and root mean square error of approximation and standardized root mean square residual values less than .06 are considered acceptable.³⁵

The first set of analyses used latent growth models of matched pairs to test the hypothesis that early intervention therapy is associated with improvements in cognitive function trajectories. A second aim of the study was to determine whether the influence of receiving early intervention therapy *differed* for varying quantities of maternal supports, at different time points (ie, potential critical periods of intervention). To address this study aim, we fit separate OLS models for each time point. An alternative approach would have been to include an interaction term in the LGM, but this would not have allowed us to investigate each follow-up period. Therefore, we fit a separate OLS model for each time point, ie, 16, 24, and 36 months, and included EI therapy, maternal supports, and an interaction term between receipt of EI therapy and maternal supports.

Latent growth models were fit in Mplus,³⁶ and all other analyses were conducted in SAS v. 9.13.³³ The institutional review board at all participating institutions approved this study. All parents provided written consent to participate.

Results

Characteristics of the study sample, by therapy group, are presented in Table 1. Before matching was performed (Table 1), infants in the early intervention groups were more likely to have a longer hospitalization in the newborn intensive care unit ($P = .001$), a younger age at gestation ($P = .003$), and more likely to have chronic lung disease ($P = .04$). The results of the stepwise logistic model to calculate propensity for receiving EI therapy is presented in Table 2. Of the 44 cases, 36 (78%) were matched to a control. The distribution, postmatching, of sociodemographic and medical characteristics of the study sample, by early intervention group suggests no differences at the .05 significance level, indicating that the matching procedures were successful (Table 3). That is, there were no differences in hospital days, gestational age, or rates of chronic lung disease between the EI and non-EI groups post-matching.

The results of the latent growth models with the matched sample (Table 4 and Fig. 1) suggest that participation in early intervention therapy is associated with better cognitive function trajectories (slope = 2.2, $P < .05$; quadratic = -0.07 , $P < .05$). The positive slope indicates a significantly greater upward trend in cognitive function scores over time. The negative quadratic term represents the inflection of the curve (ie, between 24 and 36 months postterm) and indicates a small, but significant dampening of the influence of EI participation compared to non-participation in cognitive function (Fig. 1).

In OLS models including an interaction term between maternal supports and participation in any EI, the interaction term (Table 5) was significant at 24 months ($P < .01$), and marginally significant at 16 months ($P = .05$) and 36 months ($P = .05$) postterm. The results of the interaction models suggest that among infants who receive early intervention therapy, maternal support is positively correlated with greater cognitive function at each time point. For mothers reporting 1 SD greater than the mean number of maternal supports (ie, 15 vs 11), cognitive function scores for the therapy group are 1, 7, and 4 points greater at 16 months, 24 months, and 36 months, respectively, for the EI therapy groups compared with the non-EI therapy group.

Discussion

In this paper we find that, among a sample of preterm infants matched on a host of sociodemographic and neonatal morbidity characteristics, those who receive any early intervention therapy appear to demonstrate better cognitive function trajectories than those who do not. In addition, at each time point, for preterm infants whose mothers report more supports, receipt of early intervention therapy seems to be particularly beneficial for cognitive function.

Our finding of a positive effect of early intervention therapy of cognitive function of preterm infants is consistent with a large, meta-analysis⁴ of the effect of early intervention on preterm infants' cognitive function. The authors identified 16 randomized controlled or quasi-experimental studies investigating the effects of developmental interventions (including therapy services) delivered between the ages of birth through 2 years on subsequent cognitive function. The authors conclude that although receipt of early developmental interventions is associated with a clinically significant improvement in cognitive function, heterogeneity in intervention type and frequency precluded making recommendations regarding optimal service delivery for preterm infants. To this end, our results suggest that receipt of *any* early intervention services may be associated with improved cognitive function trajectories during years 1 and 2 of age among preterm infants. To our knowledge, ours is the first study to explore the effectiveness of present day (ie, post-1986 authorization of the Individuals with Disabilities Education Act) policy-governed early developmental interventions. However, we were unable to examine specific aspects of early intervention therapy including onset, frequency, and duration. Future research should investigate specific aspects of program effectiveness.

Our findings also highlight the potential for maternal supports to augment early intervention therapy services. Caring for a medically fragile preterm infant is associated with parental psychosocial distress, which interferes with attachment and infant neurodevelopment,^{37,38} but is mitigated with maternal support interventions during the newborn period.³⁹ The longer term role of maternal supports among families of preterm infants is less wellunderstood. Indeed, the amount of perceived maternal supports among preterm infants is dynamic throughout the first 3 years of life and covaries with maternal wellbeing and infant cognitive function.⁴⁹ To this end, early intervention programs are mandated to be familycentered.⁴⁰ In practice, in addition to providing therapy, early intervention therapists also assist families with obtaining child care or public assistance, provide information on developmental milestones or medical specialists, and may be a source of emotional support during family transitions or receipt of difficult news (eg, a new diagnosis).

Lee et al⁴¹ underscore the positive influence of maternal supports on infant neurodevelopment. Our findings can contribute to the current literature by suggesting that the positive intervention effects might be greatest in the context of more maternal supports, particularly at 24 months postterm. This may suggest the importance of the early intervention clinician's dual role, that is, to provide direct therapy services and to assess or coordinate family supports. Indeed, the synergistic effect of the two appears to be most influential, especially at 24 months postterm, in promoting optimal cognitive function for infants born preterm.

We acknowledge several limitations of this study. First, propensity score matching it is not a panacea for selection bias. However, these analyses achieved a 78% matching rate, which is consistent with simulation studies³² in which authors used the macro in larger samples, which increases our confidence in the results. However, it is possible that the propensity score matching did not sufficiently reduce selection bias. Although the results were robust to

a variety of specifications, we cannot rule out the possibility of residual selection bias, but are confident that the groups are comparable.

The measurement of early intervention therapy was collected by parent report at the 36-month visit. Thus, it is possible that the results were biased by differential recall. We have no means to control for the extent to which this occurred, but the bias would likely be in the direction of underestimating an intervention effect. Similarly, the validity of parent-reported EI services, to our knowledge, has not been previously reported. However, previous authors^{42–46} suggest that parent-report is a valid proxy for utilization of health and developmental services and health status. Although this literature did not specially examine EI, it suggests that parents can validly report their children's health developmental service utilization. Moreover, the wording of the early intervention question specifically mentioned “physical, occupational, or speech therapy,” “early intervention,” and from “birth to three,” which increases the validity and reliability of parental reports. Moreover, of the children whose parents reported receipt of early intervention or special education, 100% were classified as expected according to their age (ie, all children receiving parent-reported special education were older than 36 months, and all children receiving parent-reported early intervention were younger than 36 months of age).

A related issue is that measurement of “early intervention therapy” can be problematic in a context with varying quality, intensity, and frequency of service delivery, which may limit the generalizability of our results. Moreover, families experiencing the most social disadvantage were more likely to be lost to attrition across the three years of study. This is of particular relevance given that socially disadvantaged families are more likely to experience lower child cognitive function and may experience fewer maternal supports.

Finally, our measure of perceived social support only asked about the presence rather than the quality of social support. Understanding what type of support is most helpful to mothers of preterm infants will assist in developing individualized, developmentally supportive interventions.

However, the strengths of this study underscore its public health policy and health services significance. Our findings contribute to a relatively small literature examining the effect of policy-relevant therapy services on infants born preterm. Moreover, our results, which suggest the importance of maternal supports, have important policy and programmatic implications for service delivery.

Trends in survival of preterm infants have not been matched by improvements in morbidity.⁴⁷ The effects of preterm birth are persistent and costly.⁴⁸ Understanding how effectiveness of early intervention may be bolstered has particular relevance to policy-makers, program directors, and practitioners.

Conclusion

Among a sample of preterm infants, participation in EI therapy appears to be associated with more optimal changes in cognitive function over time. For preterm infants whose mothers have more supports, receiving therapy appears particularly beneficial. Moreover, the dual influences of early intervention therapy and more maternal supports appear to be especially beneficial for infants' cognitive function at 24 months postterm.

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what's new

Early intervention therapy may be associated with improved cognitive function trajectories in a sample of preterm (<35 weeks) and low birth weight (<2500 g) infants. Also, bolstering the presence of more maternal supports may strengthen the effectiveness of early intervention therapy.

Figure 1.

Postterm cognitive function trajectories, by early intervention therapy group, for a matched sample ($n = 54$) of preterm (<35 weeks) and low birth weight (<2500 g) infants from southeastern Wisconsin.

Table 1

Descriptive Statistics Before Matching Procedures, by Therapy Group, for a Sample (n = 128) of Preterm (<35 weeks) and Low Birth Weight (<2500 g) Infants

Characteristic	Therapy (n = 41)	No Therapy (n = 87)	P Value
White, non-Hispanic, % (n)	87.8 (36)	82.8 (72)	.46
Male, % (n)	48.8 (20)	50.6 (44)	1.0
Chronic lung disease, % (n) *	17.1 (7)	5.8 (5)	.04
Multiparous, % (n)	56.1 (23)	43.7 (38)	.19
Presence of a partner, % (n)	85.4 (35)	81.6 (71)	.60
Child receives public assistance, % (n)	14.6 (6)	20.9 (18)	.40
Cognitive function, mean (SD)			
9 months	6.6 (2.1)	6.7 (1.6)	.82
16 months [†]	85.0 (13.0)	90.9 (9.1)	.004
24 months [‡]	79.3 (17.6)	81.8 (17.5)	.45
36 months [‡]	94.9 (14.3)	98.3 (12.7)	.12
Maternal support, 4 months [§]	11.1 (4.3)	10.7 (3.8)	.41
Gestational age, weeks	32 (3)	30 (4)	.003
Days hospitalized in the newborn intensive care unit	49 (36)	25 (23)	.001
Family income, US\$	78,269 (79,253)	65,567 (46,232)	.26
Maternal depressive symptoms [§]	8.6 (7.7)	8.1 (6.1)	.76

* Defined as requirement of supplemental oxygen at hospital discharge.

[†] Cognitive function was measured at 16 months using the Bayley Scale of Infant Development, Mental Developmental Index (MDI). The MDI has a mean of 100 and SD of 15. MDI scores are age-adjusted (i.e., based on postterm age). Cognitive function at 24 months and 36 months was measured using the Abbreviated Battery IQ scale (ABIQ) of the Stanford-Binet Intelligence Scale, 5th edition. The ABIQ has a mean of 100 and SD of 15. ABIQ scores are age-adjusted (i.e., based on postterm age).

[‡] Measured with the Ages and Stages Questionnaire–Third Edition.

[§] Measured with the Center for Epidemiologic Studies Depression Scale (CES-D). The CES-D asks mothers to report, on a 4-point scale (0 = rarely/none of the time to 3 = all of the time), their frequency of symptoms for 20 scale items. Scores of 16 or greater indicate symptoms of clinical depression.

Table 2

Results of Stepwise Logistic Regression Model to Calculate Propensity for Receiving Parent-Reported Early Intervention

	β	P Value
Intercept	-13.4	.024
Gestational age, weeks	0.33	.046
Days hospitalized	.06	.002

Table 3

Descriptive Statistics Post Matching Procedures, by Therapy Group, for a Sample (n = 64) of Preterm (<35 weeks) and Low Birth Weight (<2500 g) Infants

Characteristic	Therapy (n = 32)	No Therapy (n = 32)	P Value
White, non-Hispanic, % (n)	90.6 (29)	87.5 (28)	.69
Male, % (n)	46.9 (15)	50.0 (16)	.80
Chronic lung disease, % (n) *	12.5 (4)	15.6 (5)	.26
Multiparous, % (n)	53.1 (17)	46.9 (15)	.35
Presence of a partner, % (n)	87.5 (28)	81.3 (26)	.49
Child receives public assistance, % (n)	12.5 (4)	21.9 (9)	.32
Cognitive function at 9 months, mean (SD) ‡	6.8 (2.1)	6.3 (1.2)	.25
Maternal education, years, mean (SD)	15 (2)	15 (3)	.24
Gestational age, weeks, mean (SD)	31 (4)	31 (3)	.68
Days hospitalized in the newborn intensive care unit, mean (SD)	38 (32)	39 (28)	.80
Family income, US\$, mean (SD)	84,712 (87,405)	61,400 (30,330)	.17
Maternal depressive symptoms, mean (SD) ‡	9.4 (8.2)	9.3 (6.5)	.93

* Defined as requirement of supplemental oxygen at hospital discharge.

‡ Measured using the Ages and Stages Questionnaire–Third Edition.

‡ Measured with the Center for Epidemiologic Studies Depression Scale (CES-D). The CES-D asks mothers to report, on a 4-point scale (0 = rarely/none of the time to 3 = all of the time), their frequency of symptoms for 20 scale items. Scores of 16 or greater indicate symptoms of clinical depression.

Table 4

Results of Latent Growth Curve Models Predicting the Influence of EI[†] Therapy on Cognitive Function Trajectories[‡] of a Matched Sample (n = 64) of Preterm (<35 weeks) and Low Birth Weight (<2500 g) Infants

Characteristic	Intercept (SE)	Slope (SE)	Quadratic (SE)
Mean	88.6 (1.5) ***	-3.2 (0.6) ***	0.11 (0.02) ***
Variance	122.7 (22.5) ***	16.0 (3.2) ***	0.02 (0.003) ***
Covariance			
With intercept	—	-13.9(4.1) **	0.40 (0.13) **
With slope	13.9 (4.1) **	—	-0.51 (0.11) ***
EI therapy?			
Yes	-5.1 (2.8)	2.2 (1.0) *	-0.07 (0.03) *
No	Reference	Reference	Reference

Model fit: CFI = 1.00, RMSEA .0001, SRMR .001.

*
P < .05;

**
P < .01;

P < .001.

[†] CFI indicates comparative fit index; EI, early intervention; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

[‡] Cognitive function was measured at 16 months with the Bayley Scale of Infant Development, Mental Developmental Index (MDI). The MDI has a mean of 100 and SD of 15. MDI scores are age-adjusted (ie, based on postterm age). Cognitive function at 24 months and 36 months was measured with the Abbreviated Battery IQ scale (ABIQ) of the Stanford-Binet Intelligence Scale, 5th edition. The ABIQ has a mean of 100 and SD of 15. ABIQ scores are age-adjusted (ie, based on postterm age).

Table 5

Mean Difference in Cognitive Function Among a Matched Sample (n = 64) of preterm (<35 weeks) and Low Birth Weight (<2500 g)

Characteristic	Cognitive Function, [†] 16 Months	Cognitive Function, [‡] 24 Months	Cognitive Function, [‡] 36 Months
Intercept	83.0 (1.9)	78.3 (2.6)	92.3 (2.2)
EI [§] therapy?			
Yes	-5.5 (2.7)	-2.2 (3.7)	-3.4(3.1)
No	Reference	Reference	Reference
Maternal support //	-0.41 (0.53)	-1.2 (0.74)	0.97 (0.48)
EI therapy × maternal support			
Yes × maternal support	0.90 (0.42) *	2.0 (0.57) **	1.50 (0.77) *
No × maternal support	Reference	Reference	Reference

* F test, $P = .05$;

** F test, $P < .01$.

[†] Measured using the Bayely Scale of Infant Development, Mental Developmental Index (MDI). The MDI has a mean of 100 and SD of 15. MDI scores are age-adjusted (i.e., based on postterm age).

[‡] Measured using the Abbreviated Battery IQ scale (ABIQ) of the Stanford-Binet Intelligence Scale, 5th edition. The ABIQ has a mean of 100 and SD of 15. ABIQ scores are age-adjusted (i.e., based on postterm age).

[§] EI indicates early intervention.

// Maternal perceived social support was measured at 4 months using the Maternal Support scale, a multidimensional index of emotional, informational, household, child care, financial, respite, and other support, collected about the infant's father, mother's parents, in-laws, and extended family. A total perceived social support score was calculated by summing the scores of each type of support (7) across the four sources resulting in a range from 0 to 28. Continuous scores were centered at the mean.