Predictors of Poor School Readiness in Children Without Developmental Delay at Age 2

Bergen B. Nelson, MD, MS,[a,b] Rebecca N. Dudovitz, MD, MS,[a] Tumaini R. Coker, MD, MBA,[a,c] Elizabeth S. Barnert, MD, MPH,[a] Christopher Biely, MS,[a] Ning Li, PhD,[d] Peter G. Szilagyi, MD, MPH,[a] Kandyce Larson, PhD,[e] Neal Halfon, MD, MPH,[a,b] Frederick J. Zimmerman, PhD,[f] Paul J. Chung, MD, MS[a,c,f]

abstract

BACKGROUND AND OBJECTIVES: Current recommendations emphasize developmental screening and surveillance to identify developmental delays (DDs) for referral to early intervention (EI) services. Many young children without DDs, however, are at high risk for poor developmental and behavioral outcomes by school entry but are ineligible for EI. We developed models for 2-year-olds without DD that predict, at kindergarten entry, poor academic performance and high problem behaviors.

METHODS: Data from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), were used for this study. The analytic sample excluded children likely eligible for EI because of DDs or very low birth weight. Dependent variables included low academic scores and high problem behaviors at the kindergarten wave. Regression models were developed by using candidate predictors feasibly obtainable during typical 2-year well-child visits. Models were cross-validated internally on randomly selected subsamples.

RESULTS: Approximately 24% of all 2-year-old children were ineligible for EI at 2 years of age but still had poor academic or behavioral outcomes at school entry. Prediction models each contain 9 variables, almost entirely parental, social, or economic. Four variables were associated with both academic and behavioral risk: parental education below bachelor's degree, little/no shared reading at home, food insecurity, and fair/poor parental health. Areas under the receiver-operating characteristic curve were 0.76 for academic risk and 0.71 for behavioral risk. Adding the mental scale score from the Bayley Short Form–Research Edition did not improve areas under the receiver-operating characteristic curve for either model.

CONCLUSIONS: Among children ineligible for EI services, a small set of clinically available variables at age 2 years predicted academic and behavioral outcomes at school entry.

FREE NIH

[a]*Department of Pediatrics, Mattel Children's Hospital and Children's Discovery & Innovation Institute, David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, California;* [b]*UCLA Center for Healthier Children, Families and Communities, Los Angeles, California;* [c]*RAND Health, RAND Corporation, Santa Monica, California;* [d]*Department of Biomathematics, University of California, Los Angeles, Los Angeles, California;* [e]*American Academy of Pediatrics, Elk Grove Village, Illinois, and* [f]*Department of Health Policy and Management, Fielding School of Public Health, University of California, Los Angeles, Los Angeles, California*

Dr Nelson conceptualized the study design, supervised the data analyses and interpretation, and drafted the manuscript and revisions; Drs Dudovitz, Coker, Barnert, and Szilagyi assisted with study design, interpretation of data analyses, and revision of the manuscript; Mr Biely and Dr Li conducted the data analyses and assisted with interpretation of results and drafting of the manuscript; Drs Larson, Halfon, and Zimmerman provided expert consultation on study design, data analysis and interpretation, and manuscript revision; and Dr Chung supervised all aspects of

WHAT'S KNOWN ON THIS SUBJECT: Although current clinical recommendations support developmental screening and surveillance as the primary methods of detecting early developmental and behavioral concerns, developmental status alone may not accurately predict poor academic or behavioral readiness at school entry.

WHAT THIS STUDY ADDS: Among 2-year-old children likely ineligible for early intervention services, poor school readiness may be better predicted with a discrete set of clinically available variables, including family-level sociodemographic factors, than through developmental assessment alone.

To cite: Nelson BB, Dudovitz RN, Coker TR, et al. Predictors of Poor School Readiness in Children Without Developmental Delay at Age 2. *Pediatrics.* 2016;138(2):e20154477

The American Academy of Pediatrics (AAP) recommends that primary care clinicians conduct universal surveillance and screening for early childhood developmental and behavioral problems.[1,2] These recommendations are based on decades of research that demonstrate improved developmental, academic, and social outcomes from a wide range of early intervention services.[3–5] The Individuals with Disabilities Education Act requires states to provide intervention services for children with developmental disabilities, through Part C early intervention (EI) for children 0 to 36 months and Part B special education for children aged ≥3 years.[6] Eligibility criteria for EI services vary according to state but typically include demonstrated developmental delays and established risk conditions such as very low birth weight or specific genetic anomalies.[7,8] Children not eligible for EI may or may not receive other support services, depending on local availability and provider practices, and some children without delays may receive EI services.[8,9] Furthermore, there is evidence that many children with delays improve over time,[10] even without intervention,[11] suggesting that better methods are needed to identify which children need services.

Although eligibility for EI is usually based on the presence of developmental delays and disabilities, long-term developmental-behavioral and educational outcomes are strongly associated with socioeconomic factors.[12–15] Previous investigators have argued for: (1) revising the AAP developmental-behavioral surveillance and screening recommendations in children from birth to 5 years[16]; and (2) reforming the entire US EI and learning system[17] to better account for psychosocial factors. One recently introduced developmental surveillance tool, the Survey of Well-Being of Young Children,[18–20] includes assessments of potentially modifiable family risk factors such as food insecurity,[21] domestic violence,[22] tobacco[23] and other substance use,[24] and parental depression.[25] In addition, the AAP's Bright Futures guidelines[26] include recommended assessment of family psychosocial risks, and a recent AAP clinical report advocated for expanding mental health and behavioral screening in well-child care.[27] However, the specific combination of risks associated with developmental-behavioral outcomes is not clearly delineated in any practice guidelines. Meanwhile, the predictive validity of direct developmental assessment of young children using even gold standard assessment tools, much less screening instruments, has been shown to be suboptimal (positive predictive values of 37% for the Bayley Scales of Infant Development–Second Edition and 34% for the Ages and Stages Questionnaires).[28,29] Therefore, it is unclear whether, under current guidelines and recommended practices, many of the children most at risk for poor long-term developmental-behavioral trajectories are targeted to receive any support at all.

The number of 2-year-old children ineligible for Part C EI services who will have poor developmental-behavioral outcomes at kindergarten entry may be even larger than the number of equivalent Part C–eligible children.[30–32] Predicting which of these children are on such a downward trajectory likely requires assessment of family psycho-social variables. Previous studies have demonstrated steep socioeconomic gradients in cognitive outcomes at school entry[33] and have highlighted strong effects of social variables, such as maternal education, on the persistence or improvement of early developmental delays.[10] Other studies have reported associations of cognitive and social functioning at kindergarten entry with longer term academic[13,34–37] and health outcomes,[38] suggesting that poor school readiness may be linked to serious downstream consequences such as school failure, disease, and even mortality.[39–41]

The present study developed and validated risk prediction models for poor developmental-behavioral outcomes among children usually deemed ineligible for EI services.

METHODS

Data Source

The Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), is a nationally representative sample of children born in the United States in 2001 and followed up longitudinally through kindergarten entry in 2006 through 2008.[42] Data were collected from birth certificates and then parent and guardian interviews, direct child assessment, and reports from child care providers and teachers when children were ∼9 months, 24 months, 4 years, and 5 to 6 years old (kindergarten entry). Children with low birth weight were oversampled. Approximately 14 000 births were sampled for the study and yielded 10 700 cases in the first wave, for a response rate of 76%. Response rates in subsequent waves were 91% to 93%. There was a planned 15% reduction in the sample before the kindergarten entry waves; 6900 children in the kindergarten entry waves completed direct assessments. Statistical analyses (with Stata version 12 [Stata Corp, College Station, TX]) used survey sampling weights as recommended in the ECLS-B manuals. This study was approved by the University of California, Los Angeles, institutional review board; investigators were licensed to use the restricted-use ECLS-B data.

Analytic Sample

We examined records from all 6350 children with assessment data available at the 2-year wave and sampling weights in the kindergarten waves (Fig 1). Developmental delays at the 2-year wave were determined by direct child assessment by using the Bayley Short Form–Research Edition (BSF-R), mental and motor scales, adapted from the Bayley Scales of Infant Development–Second Edition.[43] We assumed developmental delay if either the BSF-R mental or motor scale score was ≥1.5 SDs below the mean or if both mental and motor scores were ≥1 SD below the mean.[7,32] Consistent with eligibility requirements for most states from the Individuals with Disabilities Education Act, Part C,[7] children were excluded if they were likely to be eligible for EI services at age 2 years, based on either: (1) very low birth weight (<1500 g); or (2) developmental delays. This subset of excluded subjects comprised 1450 children due to presumed Part C eligibility (13% of the total weighted sample), leaving an analytic sample of 4900 children for model building and validation.

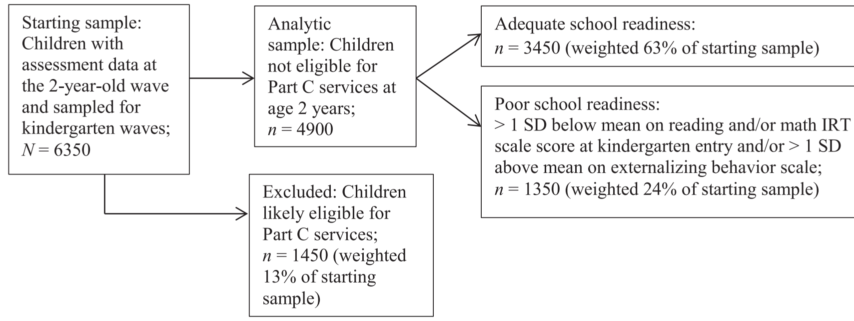

FIGURE 1
Description of analytic sample and primary outcomes. Unweighted sample sizes are rounded to the nearest 50, as required by the National Center for Education Statistics, and subsamples may not add up perfectly due to rounding as well as missing data in the kindergarten waves. Weighted proportions differ from the values obtained calculating the unweighted samples due to oversampling of children with low birth weight. IRT, item response theory. [medium]

Outcomes

We sought to understand which risk and protective factors among 2-year-old children likely ineligible for EI services predict low academic scores and high problem behaviors at kindergarten entry. Academic scores were assessed in the ECLS-B kindergarten waves by using direct measures of early literacy (basic language and literacy skills, vocabulary, understanding, and interpretation) and mathematics (number sense, counting, operations, geometry, and pattern understanding), adapted from validated tools (Peabody Picture Vocabulary Test and PreLAS 2000) for use in the Early Childhood Longitudinal Survey, Kindergarten Cohort (ECLS-K). These measures are described in detail elsewhere[33,42] and have been associated with early school function.[34] Poor academic school readiness was defined as an item response theory score ≥1 SD below the mean on early reading or mathematics tests. This cutoff represents a middle ground between previous studies that have shown worse school function among children with a range of cognitive scores, from the bottom quartile (0.67 SD below the mean) on these same assessments to an IQ ≤75 (~1.7 SD below the mean).[44]

Problem behaviors were reported by parents at the kindergarten waves by using 8 items taken from the Preschool and Kindergarten Behavior Scale (PKBS) externalizing subscale,[45] including behaviors such as aggression, impulsivity, and hyperactivity. The ECLS-B items from the PKBS externalizing subscale have previously shown better internal consistency than other PKBS items used in the ECLS-B,[46] and externalizing behaviors are highly predictive of poor academic outcomes.[44,47–49] Children were considered to have poor behavioral school readiness when they scored >1 SD above the mean on the externalizing behaviors scale (higher scores representing worse problem behaviors). This assessment was based on ECLS-K analyses showing worse school function among children with socio-emotional risks, defined as >1 SD below the mean on measures of socioemotional development.[34]

Predictors

We considered a wide range of variables as candidate predictors, based on previous studies. Measures were prioritized that could be feasibly obtained during a typical 2-year well-child visit through parent report or administrative data. Child-level variables included sex,[15,34,47] race/ethnicity,[34,50–52] gestational age (<34, 34–36 weeks, and ≥37 weeks),[15,47,53,54] low birth weight (<2500 g),[10,34,47] parent-reported child health status,[50] breastfeeding history (0–3 months or ≥4 months),[55] enrollment in Medicaid,[56,57] enrollment in the Supplemental Nutrition Program for Women, Infants, and Children,[56–58] participation in a center-based child care program,[59] whether the child combines words at age 2 years,[60] and parent's expectation for the child's educational attainment.[33,59] Family-level variables included mother's age,[49] highest level of parental education,[10,33,49] household income and poverty status,[10,33,49,50,56,61] whether both parents live with the child,[34,49,62] primary language spoken at home (English or other language),[51,52] whether parent is a US citizen,[63] self-reported parental health status,[50] family history of learning disability,[64] household food insecurity (based on 6 US Department of Agriculture survey items),[65,66] history of parental depression,[67,68] current parental smoking,[46,49,69] and frequency of shared reading with the child.[15,33,59] Home- and neighborhood-level variables included quality of home for raising children, quality of neighborhood for raising children, and neighborhood safety (all based on parent report).[70]

Security of toddler attachment and parent supportiveness[33,71–73] were measured in the ECLS-B through direct observation. We excluded these variables, however, out of concern that they might not be feasibly and reliably obtainable during well-child visits.

Model Selection and Validation

Analyses were conducted by using the "svy" suite of commands in Stata version 12 to account for the 3 survey design elements: stratification, clustering, and weighting. Separate models were developed to predict poor school readiness based on low academic scores or high problem behaviors. Because parsimony might enhance clinical applicability, these 2 logistic regression models were built by using a forward selection process, adding variables 1 by 1, based on incremental increase in the area under the receiver-operating characteristic curve (AUC) of the overall model, with a threshold of $P < .05$ as the limit for inclusion. We also tested the AUC for the BSF-R mental scale alone and added it to each of the final models to investigate the incremental increase in AUC provided by the BSF-R score. Finally, we developed a risk index for each outcome, based on predicted probability transformed into a linear predictor and scaled to represent scores from 0 (lowest risk) to 100 (highest risk).

Both prediction models were then cross-validated internally. The analytic sample was split into 2 equal-sized, randomly selected subsamples. Cross-validation was then performed, with the prediction models fit to 1 subsample and tested on the other, and vice versa.[74] Validation statistics included the AUC, Brier score (mean squared difference between the predicted probability and the observed outcome, with 0 the best and 1 the worst),[75] and calibration slope (regression slope of the linear predictor, with optimal performance equal to 1),[76] all designed to measure the accuracy of the predictions. Validation statistics were calculated taking survey weights into account, and the average performance of the prediction models was calculated over the 2 repetitions.

RESULTS

Among the 4900 children aged 2 years in the analytic sample, 1350 demonstrated poor school readiness at the time of kindergarten entry, either due to low academic scores or high problem behaviors (Fig 1). These results indicate that nearly one-quarter of all 2-year-old children appeared ineligible for EI services but nevertheless demonstrated inadequate school readiness at kindergarten entry.

Table 1 displays the characteristics of the analytic sample, with weighted proportions of each candidate predictor considered in the risk prediction model selection process, separated into subsamples based on the outcomes of interest: adequate school readiness, poor school readiness due to low academic scores, poor school readiness due to high behavior problems, and poor school readiness based on both low academic scores and high problem behaviors. All candidate variables demonstrated statistically significant bivariate associations with the outcomes of interest. Missing data for these variables ranged from 0% to 4%.

After the forward selection process, 9 candidate predictors were retained in each of the final models predicting risk for poor school readiness due to poor academic scores (Table 2) or behavioral function (Table 3) at kindergarten entry. Four predictors are present in both models: highest level of parental education, self-reported parental health status, frequency of shared reading with child at home, and food insecurity. Predictors retained in the academic risk model also included: child not combining words at age 2 years; parental expectation of child educational attainment at less than a 4-year college degree; household income <185% of the federal poverty level; family history of learning disability; and parental rating of the quality of the house for raising children (good/fair/poor versus very good/excellent). Predictors retained in the behavioral risk model also included: child sex; single-parent household; and parental depression, smoking, and rating of neighborhood safety. The AUC for the academic model was 0.76, and the AUC for the behavior model was 0.71.

The unadjusted odds ratio of the standardized, BSF-R mental scale t score was 0.92 (95% confidence interval, 0.91–0.93) in predicting low academic scores and 0.96 (95% confidence interval, 0.95–0.97) in predicting high problem behavior. We also tested whether adding the BSF-R score at age 2 years would substantially improve the predictive ability of the models. The AUC of the BSF-R mental score alone in predicting low academic scores was 0.67, and for problem behaviors it was 0.60. Adding the BSF-R to the final risk prediction models increased the AUC of the academic risk model minimally (from 0.76 to 0.77) and did not change the AUC of the behavior risk model.

Using the aforementioned model-validation approach, the averages for the AUC, Brier score, and calibration

TABLE 1 Characteristics of 2-Year-Old Children Likely Ineligible for Part C Intervention Services

Variables Considered in Model Selection	Poor School Readiness at Kindergarten (High Problem Behaviors or Low Academic Scores) (n = 1350)			Adequate School Readiness at Kindergarten (n = 3450)
	High Problem Behaviors and Low Academic Scores (n = 200)	High Problem Behaviors (n = 650)	Low Academic Scores (n = 900)	
Child-level				
Sex				
Male	0.67	0.62	0.54	0.46
Female	0.33	0.38	0.46	0.54
Race/ethnicity				
White, non-Hispanic	0.39	0.49	0.40	0.60
African American	0.19	0.18	0.18	0.12
Hispanic or Latino	0.34	0.25	0.37	0.20
Asian	0.01	0.02	0.01	0.03
Multiracial or other	0.08	0.06	0.04	0.05
Gestational age				
<34 wk	0.01	0.02	0.03	0.02
34–36+6/7 wk	0.10	0.10	0.09	0.08
≥37 wk	0.89	0.88	0.88	0.91
Birth weight				
≥2500 g	0.91	0.93	0.93	0.95
<2500 g	0.09	0.07	0.07	0.05
Parent-reported child health status				
Excellent or very good	0.86	0.85	0.85	0.91
Good, fair, or poor	0.14	0.15	0.15	0.09
Breastfeeding				
≥4 mo	0.28	0.30	0.32	0.45
0–3 mo	0.72	0.70	0.68	0.55
Child has Medicaid	0.65	0.52	0.53	0.26
Child enrolled in WIC	0.68	0.57	0.60	0.33
Child is in center-based child care at 2 y	0.13	0.18	0.13	0.18
Child does not combine words	0.17	0.16	0.19	0.10
Parent's expectation for child's highest education				
4-y degree or higher	0.57	0.64	0.64	0.81
<4-y degree	0.43	0.36	0.36	0.19
Parent/family-level				
Mother's age, mean ± SD, y	24.8 ± 5.9	25.5 ± 5.8	25.5 ± 5.9	28.0 ± 5.7
Highest level of parental education				
Bachelor's degree or higher	0.05	0.17	0.11	0.40
Some college	0.22	0.24	0.19	0.27
High school diploma	0.44	0.42	0.42	0.25
Less than high school diploma	0.29	0.17	0.28	0.08
Household income/poverty status				
≥185% of FPL	0.25	0.39	0.31	0.64
100%–185% of FPL	0.27	0.26	0.28	0.20
<100% of FPL	0.48	0.35	0.41	0.16
Single-parent household	0.35	0.34	0.30	0.17
English is primary home language	0.79	0.84	0.74	0.85
Parent is US citizen	0.85	0.88	0.79	0.88
Self-reported health status of parent				
Good to excellent	0.77	0.84	0.84	0.95
Fair or poor	0.23	0.16	0.16	0.05
Family history of learning disability	0.32	0.22	0.21	0.13
Food insecurity	0.19	0.15	0.14	0.05
Parental depression	0.25	0.22	0.16	0.13
Parental smoking	0.42	0.34	0.26	0.16
Frequency of shared reading with child				
Every day	0.30	0.40	0.32	0.53
3–6 times/wk	0.23	0.25	0.27	0.26
1–2 times/wk	0.37	0.30	0.36	0.20
Not at all	0.10	0.05	0.05	0.02
Home/neighborhood-level				

TABLE 1 Continued

Variables Considered in Model Selection	Poor School Readiness at Kindergarten (High Problem Behaviors or Low Academic Scores) (*n* = 1350)			Adequate School Readiness at Kindergarten (*n* = 3450)
	High Problem Behaviors and Low Academic Scores (*n* = 200)	High Problem Behaviors (*n* = 650)	Low Academic Scores (*n* = 900)	
Quality of house for raising children				
Excellent or very good	0.48	0.59	0.56	0.75
Good, fair, or poor	0.52	0.41	0.44	0.25
Quality of neighborhood for raising children				
Excellent or very good	0.40	0.53	0.48	0.69
Good, fair or poor	0.60	0.47	0.52	0.31
Neighborhood safety				
Very or fairly safe	0.72	0.82	0.86	0.94
Fairly or very unsafe	0.28	0.18	0.14	0.06

For all candidate predictor variables, we present the weighted proportion of each variable in the subsample represented in each column, except for maternal age, which is presented as the mean ± SD. FPL, federal poverty level; LD, learning disability; WIC, Supplemental Nutrition Program for Women, Infants, and Children.

slope were 0.75, 0.1358, and 0.9130, respectively, for the academic model, and 0.69, 0.1034, and 0.8554 for the behavior model. These validation measures suggest that the prediction models work fairly well, although a calibration slope of <0.9 for the behavioral model indicates that predictions are widely spread (closer to 0 and 1) and that its predictive ability may vary when applied to new sets of data. Based on a sensitivity of each model set at 0.60, 0.70, and 0.80, Table 4 presents the corresponding specificity and calculated cutoff scores for the scaled risk index, along with the proportion of the population at or above that score and corresponding information for the BSF-R mental scale.

TABLE 2 Predictors at Age 2 Years for Low Academic Scores at Kindergarten Entry

Predictor	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Risk Index Weight (= β/5.3 × 100)
Child does not combine words	2.0 (1.5–2.7)	1.7 (1.2–2.3)	9.8
Parent's expectation for child's highest education is less than a 4-y degree	2.2 (1.8–2.8)	1.3 (1.0–1.7)	5.1
Highest level of parental education: (bachelor's degree or higher is reference)			
Some college	2.4 (1.8–3.4)	1.7 (1.2–2.5)	10.3
High school diploma or equivalent	5.4 (4.0–7.3)	3.1 (2.2–4.3)	21.1
Less than high school diploma	11.2 (8.0–15.8)	5.2 (3.5–7.9)	31.2
Parent health status is fair or poor	3.0 (2.3–4.0)	1.5 (1.1–2.1)	8.2
Household income is <185% of FPL	3.6 (2.9–4.4)	1.4 (1.1–1.8)	6.0
Frequency of shared reading at home (every day is reference)			
3–6 times/wk	1.7 (1.3–2.2)	1.3 (1.0–1.8)	5.4
1–2 times/wk	2.8 (2.2–3.6)	1.6 (1.2–2.1)	8.4
Not at all	4.6 (2.9–7.1)	2.1 (1.3–3.5)	14.1
Family has food insecurity	2.9 (2.1–4.1)	1.7 (1.2–2.4)	9.5
Family history of learning disability	1.6 (1.3–2.1)	1.6 (1.2–2.1)	9.2
Parent rates quality of house as good, fair, or poor for raising children	2.2 (1.8–2.7)	1.4 (1.1–1.8)	6.7

Unadjusted odds ratios (ORs) were derived from bivariate logistic regressions by using each predictor individually to calculate association with low academic scores (≥1 SD below mean on language and/or math assessment) at kindergarten. Adjusted ORs and regression coefficients were calculated by using a multivariate logistic regression that includes all of the variables listed in the table. Regression coefficients (β) were used to weight each variable to calculate the risk index, which was scaled to represent a range from 0 (lowest risk) to 100 (highest risk), using the maximum possible sum of all β values (5.3). CI, confidence interval; FPL, federal poverty level.

DISCUSSION

To the best of our knowledge, this study is the first published report to characterize, at a national level, the large population of young children who are likely ineligible for EI but who are nevertheless at high risk for poor cognitive and behavioral outcomes at kindergarten entry. This group accounts for up to one-quarter of all 2-year-old children who, under current practice guidelines, often do not receive any targeted supports unless more serious consequences occur. When combined with the ~13% of children who may be eligible for EI but often do not actually receive services,[32] the level of unmet need in the present system of care is tremendous. This study provides 2 potentially clinically feasible risk-prediction models that identify children who might benefit from timely developmental support, based on a short set of parent-report and administrative data. The models demonstrated reasonable sensitivity and specificity, with better predictive validity than developmental assessment alone, including after cross-validation on split samples of the data set.

The risk and protective factors found in the prediction models presented here have been associated with developmental outcomes in previous studies. There is a vast literature documenting the detrimental effects of poverty on child development,[10,12–15,33,34,49,50,57,59,61]

TABLE 3 Predictors at Age 2 Years for Problem Behaviors at Kindergarten Entry

Predictor	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Risk Index Weight (= β/4.9 × 100)
Male sex	1.9 (1.4–2.5)	1.8 (1.4–2.4)	12.4
Highest level of parental education (bachelor's degree or higher is reference)			
Some college	2.0 (1.5–2.7)	1.4 (1.0–1.9)	7.1
High school diploma or equivalent	3.2 (2.4–4.3)	1.9 (1.3–2.7)	12.9
Less than high school diploma	3.2 (2.3–4.5)	1.5 (1.0–2.3)	8.2
Parent health status is fair or poor	2.7 (1.9–4.0)	1.8 (1.2–2.6)	11.6
Single-parent household	2.2 (1.7–2.8)	1.5 (1.2–2.0)	8.8
Parental depression	1.9 (1.4–2.7)	1.4 (1.0–2.0)	7.5
Parental smoking	2.5 (1.9–3.1)	1.8 (1.4–2.4)	12.4
Frequency of shared reading at home (every day is reference)			
3–6 times/wk	1.2 (0.9–1.6)	0.9 (0.6–1.3)	−2.1
1–2 times/wk	1.6 (1.2–2.2)	1.1 (0.8–1.6)	2.2
Not at all	2.7 (1.6–4.6)	1.7 (1.1–2.8)	11.3
Family has food insecurity	2.6 (1.8–4.0)	1.6 (1.1–2.5)	10.0
Parent rates neighborhood as fairly or very unsafe	2.9 (2.1–4.1)	2.0 (1.4–2.8)	13.6

Unadjusted odds ratios (ORs) were derived from bivariate logistic regressions by using each predictor individually to calculate association with high externalizing behaviors (>1 SD above mean) at kindergarten. Adjusted ORs and regression coefficients were calculated by using a multivariate logistic regression that includes all of the variables listed in the table. Regression coefficients (β) were used to weight each variable to calculate the risk index, which was scaled to a range of 0 (lowest risk) to 100 (highest risk) using the maximum sum of all β values (4.9). CI, confidence interval.

but understanding the effects of additional risk and protective factors may be helpful in discriminating clinically between children likely to be resilient versus vulnerable to poor developmental outcomes. Previous ECLS-B analyses showed increased risks of cognitive delay at 9 months with higher social risk index scores (including race, poverty, low maternal education, single-parent household, and ≥3 children in the home).[77] Others have found that maternal education and frequency of shared reading, in addition to household income, were associated with early elementary academic scores.[15] Similarly, members of our research group recently found that parenting behaviors and expectations between 9 months and 3 to 4 years may mitigate the steep socioeconomic gradient seen in cognitive development at the time of kindergarten entry.[33] Other predictors in our models (child sex,[15,34,49] parental smoking,[46,69] parental depression,[67,68] family history of learning disability,[64] and food insecurity[65,66]) have also been associated with worse cognitive and/or behavioral outcomes for children in previous research. However, several predictors found in our study are novel: self-reported parental health status, parent-rated neighborhood safety, and parent-rated quality of house for raising children. Although these questions may not be currently assessed routinely, these items could be asked of parents before or during well-child visits to improve prediction of developmental-behavioral risk.

Although many clinicians focus on biological factors such as perinatal risks and low birth weight, social influences may prove more predictive of longer term developmental and academic outcomes. A recent ECLS-B study found that although late-preterm infants had worse academic scores than term infants, BSF-R scores had poor predictive validity, and maternal education, race, and family income were also associated with academic readiness.[53] In the present study, which excluded

TABLE 4 Cutoff Scores for Risk Indices at Selected Sensitivity and Specificity Values

Low Academic Scores						High Problem Behaviors					
Risk Index		Cutoff Score	Proportion Positive	BSF-R		Risk Index		Cutoff Score	Proportion Positive	BSF-R	
Sens.[a]	Spec.			Sens.[a]	Spec.	Sens.[a]	Spec.			Sens.[a]	Spec.
0.60	0.78	38	0.28	0.60	0.64	0.60	0.72	27	0.32	0.60	0.55
0.70	0.68	32	0.38	0.70	0.53	0.70	0.60	22	0.41	0.70	0.45
0.80	0.57	25	0.50	0.80	0.41	0.80	0.46	16	0.57	0.80	0.34

[a] We set sensitivity at 0.60, 0.70, and 0.80 for each model and show the corresponding specificity, cutoff score (rounded to the nearest whole number), and estimated proportion of the population screening positive, at or above each cutoff score, weighted to reflect ECLS-B sampling design. The corresponding sensitivities and specificities of the BSF-R mental scale are also shown, for comparison.

very low birth weight children and children demonstrating early developmental delays, birth weight and gestational age did not exhibit associations with developmental or behavioral outcomes. A previous ECLS-B study assessing children with developmental delay at the 2- and 4-year waves similarly showed that, although low and very low birth weight were associated with higher risk of developmental delay at age 2 years, maternal education and family income became much stronger predictors for delays in 4-year-old children and were highly predictive of persistent delays.[10] These studies, and our analyses, support the need for universal family psychosocial screening in early childhood. Our findings could improve future revisions of family psychosocial screening instruments routinely used in primary care. For example, the Survey of Well-Being of Young Children screens for parental tobacco use, food insecurity, and parental depression but not for other predictive academic and behavioral risk factors such as parental education level below bachelor's degree and little or no shared reading at home.

The present study has several limitations. We developed the models and validated them internally using the same data set, which may have resulted in over-optimized models. The sensitivity and specificity of the models we present here are not optimal as stand-alone screening instruments, although they would likely improve prediction of poor school readiness compared with the current practice of using developmental screening alone. We were also limited by the variables available in the ECLS-B, and thus created cutoffs, which may have limited applicability in practice. For example, we used a numerical definition of EI eligibility that has been used previously[32] but differs from the actual eligibility in many states, with 22 different numerical definitions currently used across the United States.[8] Because there are likely to be other developmental-behavioral variables important to school readiness, our specific choices of outcome measures (academic scores and externalizing behaviors) may not capture all of the children at risk. We limited the candidate predictors to variables that could be feasibly obtained in a typical clinical encounter, thus excluding variables that could improve predictive validity, such as direct observation of attachment security and parent–child interactions. As clinical tools evolve, and these direct clinical observations become more feasible, we should revisit these analyses and consider including those factors to create more optimal models.

Identifying children with serious developmental-behavioral risks who are ineligible for formal EI services raises the difficult but important policy and clinical question of how best to support these children to mitigate their predictable risks for poor school readiness. Given that EI services currently fail to consistently reach eligible children,[8,32] proposing that a much larger group of children at high risk now be given full access to EI seems impractical without increases in Part C funding. Although additional research is needed to better determine best policies and practices, several categories of development-supporting interventions have demonstrated effectiveness for children at high risk and are available in many communities. Interventions that typically fall outside of Part C EI services (such as high-quality early care and education programs,[4,78] evidence-based Maternal, Infant, and Early Childhood Home Visiting programs,[79] parent training programs,[80,81] and brief interventions delivered in primary care settings,[82–84] including Reach Out And Read,[85] the Video Interaction Project,[86,87] and others) might be important resources to emphasize for high-risk families and to teach pediatric trainees.[88] Finally, partnering with care coordination programs such as Help Me Grow[89] or 2-1-1[90] could help connect targeted interventions with the children and families most in need.

CONCLUSIONS

A discrete set of variables, obtained through parent report or administrative data, may predict which 2-year-old children without overt and identifiable developmental delays will have low academic scores and high problem behaviors at kindergarten entry better than common developmental assessment tools. These variables largely consist of family-level socioeconomic factors, which are not systematically considered in current developmental screening and surveillance practices but could be feasibly obtained, with several included in a recent AAP policy statement on poverty.[91] Including identification of these risk factors in clinical practice, along with recommended developmental screening and surveillance, may identify a large group of young children who have developmental-behavioral risks that could benefit from additional support.

ABBREVIATIONS

AAP: American Academy of Pediatrics
AUC: area under the receiver-operating characteristic curve
BSF-R: Bayley Short Form–Research Edition
ECLS-B: Early Childhood Longitudinal Study, Birth Cohort
EI: early intervention
PKBS: Preschool and Kindergarten Behavior Scale

the study, from conceptualization and study design, to data analyses and interpretation, and writing of the manuscript. All authors approved the final manuscript as it is presented.

DOI: 10.1542/peds.2015-4477

Accepted for publication May 16, 2016

Address correspondence to Bergen B. Nelson, MD, MS, UCLA Department of Pediatrics, 10833 Le Conte Ave, B2-449 MDCC, Los Angeles, CA 90095. E-mail: bnelson@mednet.ucla.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by grants UL1TR000124 and KL2TR000122 from the National Institutes of Health/National Center for Advancing Translational Science, through the UCLA Clinical and Translational Sciences Institute. Dr Coker was supported by a career development award from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (K23-HD06267). Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2016-0432.

REFERENCES

1. Council on Children With Disabilities; Section on Developmental Behavioral Pediatrics; Bright Futures Steering Committee; Medical Home Initiatives for Children With Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. *Pediatrics*. 2006;118(1):405–420
2. Johnson CP, Myers SM; American Academy of Pediatrics Council on Children With Disabilities. Identification and evaluation of children with autism spectrum disorders. *Pediatrics*. 2007;120(5):1183–1215
3. Guralnick M. *The Effectiveness of Early Intervention*. Baltimore, MD: PH Brookes; 1997
4. Reynolds AJ, Temple JA. Cost-effective early childhood development programs from preschool to third grade. *Annu Rev Clin Psychol*. 2008;4:109–139
5. Heckman JJ. Schools, skills, and synapses. *Econ Inq*. 2008;46(3):289–324
6. Public Law 108-446. Individuals with Disabilities Education Act. Statutes and regulations. Available at: http://idea.ed.gov. Accessed September 1, 2015
7. Ringwalt S. Summary table of states' and territories' definitions of/criteria for IDEA Part C eligibility. 2012. Available at: http://ectacenter.org/~pdfs/topics/earlyid/partc_elig_table.pdf. Accessed September 1, 2015
8. Rosenberg SA, Robinson CC, Shaw EF, Ellison MC. Part C early intervention for infants and toddlers: percentage eligible versus served. *Pediatrics*. 2013;131(1):38–46
9. Tang BG, Feldman HM, Huffman LC, Kagawa KJ, Gould JB. Missed opportunities in the referral of high-risk infants to early intervention. *Pediatrics*. 2012;129(6):1027–1034
10. Hillemeier MM, Morgan PL, Farkas G, Maczuga SA. Perinatal and socioeconomic risk factors for variable and persistent cognitive delay at 24 and 48 months of age in a national sample. *Matern Child Health J*. 2011;15(7):1001–1010
11. McManus BM, Robinson CC, Rosenberg SA. Identifying infants and toddlers at high risk for persistent delays. *Matern Child Health J*. 2016;20(3):639–645
12. Sameroff AJ, Seifer R, Barocas R, Zax M, Greenspan S. Intelligence quotient scores of 4-year-old children: social-environmental risk factors. *Pediatrics*. 1987;79(3):343–350
13. Walker D, Greenwood C, Hart B, Carta J. Prediction of school outcomes based on early language production and socioeconomic factors. *Child Dev*. 1994;65(spec no 2):606–621
14. Glascoe FP, Leew S. Parenting behaviors, perceptions, and psychosocial risk: impacts on young children's development. *Pediatrics*. 2010;125(2):313–319
15. Pati S, Hashim K, Brown B, Fiks AG, Forrest CB. Early identification of young children at risk for poor academic achievement: preliminary development of a parent-report prediction tool. *BMC Health Serv Res*. 2011;11:197
16. Marks KP, Page Glascoe F, Macias MM. Enhancing the algorithm for developmental-behavioral surveillance and screening in children 0 to 5 years. *Clin Pediatr (Phila)*. 2011;50(9):853–868
17. Marks KP, Griffen AK, Herrera P, Macias MM, Rice CE, Robinson C. Systemwide solutions to improve early intervention for developmental-behavioral concerns. *Pediatrics*. 2015;136(6). Available at: www.pediatrics.org/cgi/content/full/136/6/e1492
18. Sheldrick RC, Perrin EC. Evidence-based milestones for surveillance of cognitive, language, and motor development. *Acad Pediatr*. 2013;13(6):577–586
19. Sheldrick RC, Henson BS, Neger EN, Merchant S, Murphy JM, Perrin EC. The baby pediatric symptom checklist: development and initial validation of a new social/emotional screening instrument for very young children. *Acad Pediatr*. 2013;13(1):72–80
20. Sheldrick RC, Henson BS, Merchant S, Neger EN, Murphy JM, Perrin EC. The Preschool Pediatric Symptom Checklist (PPSC): development and initial validation of a new social/emotional screening instrument. *Acad Pediatr*. 2012;12(5):456–467

21. Kleinman RE, Murphy JM, Wieneke KM, Desmond MS, Schiff A, Gapinski JA. Use of a single-question screening tool to detect hunger in families attending a neighborhood health center. *Ambul Pediatr*. 2007;7(4):278–284

22. Brown JB, Lent B, Schmidt G, Sas G. Application of the Woman Abuse Screening Tool (WAST) and WAST-short in the family practice setting. *J Fam Pract*. 2000;49(10):896–903

23. Winickoff JP, Park ER, Hipple BJ, et al. Clinical effort against secondhand smoke exposure: development of framework and intervention. *Pediatrics*. 2008;122(2). Available at: www.pediatrics.org/cgi/content/full/122/2/e363

24. Brown RL, Leonard T, Saunders LA, Papasouliotis O. A two-item conjoint screen for alcohol and other drug problems. *J Am Board Fam Pract*. 2001;14(2):95–106

25. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Med Care*. 2003;41(11):1284–1292

26. Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children and Adolescents*. 3rd ed. Elk Grove, IL: American Academy of Pediatrics; 2008

27. Weitzman C, Wegner L; Section on Developmental and Behavioral Pediatrics; Committee on Psychosocial Aspects of Child and Family Health; Council on Early Childhood; Society for Developmental and Behavioral Pediatrics; American Academy of Pediatrics. Promoting optimal development: screening for behavioral and emotional problems. *Pediatrics*. 2015;135(2):384–395

28. Hack M, Taylor HG, Drotar D, et al. Poor predictive validity of the Bayley Scales of Infant Development for cognitive function of extremely low birth weight children at school age. *Pediatrics*. 2005;116(2):333–341

29. Rydz D, Srour M, Oskoui M, et al. Screening for developmental delay in the setting of a community pediatric clinic: a prospective assessment of parent-report questionnaires. *Pediatrics*. 2006;118(4). Available at: www.pediatrics.org/cgi/content/full/118/4/e1178

30. Glascoe FP. Are overreferrals on developmental screening tests really a problem? *Arch Pediatr Adolesc Med*. 2001;155(1):54–59

31. Nelson BB, Chung PJ, Forness SR, et al. Developmental and health services in head start preschools: a tiered approach to early intervention. *Acad Pediatr*. 2013;13(2):145–151

32. Rosenberg SA, Zhang D, Robinson CC. Prevalence of developmental delays and participation in early intervention services for young children. *Pediatrics*. 2008;121(6). Available at: www.pediatrics.org/cgi/content/full/121/6/e1503

33. Larson K, Russ SA, Nelson BB, Olson LM, Halfon N. Cognitive ability at kindergarten entry and socioeconomic status. *Pediatrics*. 2015;135(2). Available at: www.pediatrics.org/cgi/content/full/135/2/e440

34. Hair E, Halle T, Terry-Humen E, Lavelle B, Calkins J. Children's school readiness in the ECLS-K: Predictions to academic, health and social outcomes in first grade. *Early Child Res Q*. 2006;21(4):431–454

35. Snow CE, Porche MV, Tabors PO, Harris SR, eds. *Is Literacy Enough? Pathways to Academic Success for Adolescents*. Baltimore, MD: Paul H. Brookes; 1997

36. Casillas A, Robbins S, Allen J, Kuo YL, Hanson MA, Schmeiser C. Predicting early academic failure in high school from prior academic achievement, psychosocial characteristics, and behavior. *J Educ Psychol*. 2012;104(2):407–420

37. Suh S, Suh J, Houston I. Predictors of categorical at-risk high school dropouts. *J Couns Dev*. 2007;85(2):196–203

38. Power C, Hertzman C. Social and biological pathways linking early life and adult disease. *Br Med Bull*. 1997;53(1):210–221

39. Freudenberg N, Ruglis J. Reframing school dropout as a public health issue. *Prev Chronic Dis*. 2007;4(4):A107

40. Molla MT, Madans JH, Wagener DK. Differentials in adult mortality and activity limitation by years of education in the United States at the end of the 1990s. *Popul Dev Rev*. 2004;30(4):625–646

41. Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *JAMA*. 1998;279(21):1703–1708

42. Snow K, Derecho A, Wheeless S, et al. *Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), Kindergarten 2006 and 2007 Data File User's Manual (2010-010)*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, US Department of Education; 2009

43. Bayley N. *The Bayley Scales of Infant Development-II*. San Antonio, TX: The Psychological Corporation; 1993

44. Blair C. The early identification of risk for grade retention among African American children at risk for school difficulty. *Appl Dev Sci*. 2001;5(1):37–50

45. Merrell KM. Preschool and Kindergarten Behavior Scales (PKBS-2). Available at: www.proedinc.com/customer/productView.aspx?ID=2285. Accessed September 1, 2015

46. Boutwell BB, Beaver KM. Maternal cigarette smoking during pregnancy and offspring externalizing behavioral problems: a propensity score matching analysis. *Int J Environ Res Public Health*. 2010;7(1):146–163

47. Byrd RS, Weitzman M, Auinger P. Increased behavior problems associated with delayed school entry and delayed school progress. *Pediatrics*. 1997;100(4):654–661

48. La Paro KM, Pianta RC. Predicting children's competence in the early school years: a meta-analytic review. *Rev Educ Res*. 2000;70(4):443–484

49. Byrd RS, Weitzman ML. Predictors of early grade retention among children in the United States. *Pediatrics*. 1994;93(3):481–487

50. Currie J. Health disparities and gaps in school readiness. *Future Child*. 2005;15(1):117–138

51. Fuller B, Bridges M, Bein E, et al. The health and cognitive growth of Latino toddlers: at risk or immigrant paradox? *Matern Child Health J*. 2009;13(6):755–768

52. Guerrero AD, Fuller B, Chu L, et al. Early growth of Mexican-American children:

lagging in preliteracy skills but not social development. *Matern Child Health J*. 2013;17(9):1701–1711

53. Woythaler M, McCormick MC, Mao WY, Smith VC. Late preterm infants and neurodevelopmental outcomes at kindergarten. *Pediatrics*. 2015;136(3):424–431
54. Woythaler MA, McCormick MC, Smith VC. Late preterm infants have worse 24-month neurodevelopmental outcomes than term infants. *Pediatrics*. 2011;127(3). Available at: www.pediatrics.org/cgi/content/full/127/3/e622
55. Anderson JW, Johnstone BM, Remley DT. Breast-feeding and cognitive development: a meta-analysis. *Am J Clin Nutr*. 1999;70(4):525–535
56. Currie JM. Choosing among alternative programs for poor children. *Future Child*. 1997;7(2):113–131
57. Devaney BL, Ellwood MR, Love JM. Programs that mitigate the effects of poverty on children. *Future Child*. 1997;7(2):88–112
58. Jackson MI. Early childhood WIC participation, cognitive development and academic achievement. *Soc Sci Med*. 2015;126:145–153
59. Judge S. Resilient and vulnerable at-risk children: Protective factors affecting early school competence. *J Child Poverty*. 2005;11(2):149–168
60. Morgan PL, Farkas G, Hillemeier MM, Hammer CS, Maczuga S. 24-Month-old children with larger oral vocabularies display greater academic and behavioral functioning at kindergarten entry. *Child Dev*. 2015;86(5):1351–1370
61. Duncan GJ, Brooks-Gunn J. Family poverty, welfare reform, and child development. *Child Dev*. 2000;71(1):188–196
62. Gross SJ, Mettelman BB, Dye TD, Slagle TA. Impact of family structure and stability on academic outcome in preterm children at 10 years of age. *J Pediatr*. 2001;138(2):169–175
63. Mistry RS, Biesanz JC, Chien N, Howes C, Benner AD. Socioeconomic status, parental investments, and the cognitive and behavioral outcomes of low-income children from immigrant and native households. *Early Child Res Q*. 2008;23(2):193–212
64. Vogler GP, DeFries JC, Decker SN. Family history as an indicator of risk for reading disability. *J Learn Disabil*. 1985;18(7):419–421
65. Rose-Jacobs R, Black MM, Casey PH, et al. Household food insecurity: associations with at-risk infant and toddler development. *Pediatrics*. 2008;121(1):65–72
66. Jyoti DF, Frongillo EA, Jones SJ. Food insecurity affects school children's academic performance, weight gain, and social skills. *J Nutr*. 2005;135(12):2831–2839
67. Kurstjens S, Wolke D. Effects of maternal depression on cognitive development of children over the first 7 years of life. *J Child Psychol Psychiatry*. 2001;42(5):623–636
68. Grace SL, Evindar A, Stewart DE. The effect of postpartum depression on child cognitive development and behavior: a review and critical analysis of the literature. *Arch Women Ment Health*. 2003;6(4):263–274
69. Weitzman M, Gortmaker S, Sobol A. Maternal smoking and behavior problems of children. *Pediatrics*. 1992;90(3):342–349
70. Brooks-Gunn J, Duncan GJ, Kleanov PK, Sealand N. Do neighborhoods influence child and adolescent development?. *Am J Sociol*. 1993;99(2):353–395
71. Tamis-LeMonda CS, Shannon JD, Cabrera NJ, Lamb ME. Fathers and mothers at play with their 2- and 3-year-olds: contributions to language and cognitive development. *Child Dev*. 2004;75(6):1806–1820
72. Smith KE, Landry SH, Swank PR. The role of early maternal responsiveness in supporting school-aged cognitive development for children who vary in birth status. *Pediatrics*. 2006;117(5):1608–1617
73. Siegel DJ. Toward an interpersonal neurobiology of the developing mind: attachment relationships, "mindsight," and neural integration. *Infant Ment Health J*. 2001;22(1–2):67–94
74. Steyerberg EW, Harrell FE Jr, Borsboom GJ, Eijkemans MJ, Vergouwe Y, Habbema JD. Internal validation of predictive models: efficiency of some procedures for logistic regression analysis. *J Clin Epidemiol*. 2001;54(8):774–781
75. Brier GW. Verification of forecasts expressed in terms of probability. *Mon Weather Rev*. 1950;78:1–3
76. Cox DR. Two further applications of a model for binary regression. *Biometrika*. 1958;45:562–565
77. Cheng ER, Poehlmann-Tynan J, Mullahy J, Witt WP. Cumulative social risk exposure, infant birth weight, and cognitive delay in infancy. *Acad Pediatr*. 2014;14(6):581–588
78. US Department of Health and Human Services, Administration for Children and Families, Office of Planning, Research and Evaluation. Making a difference in the lives of infants and toddlers and their families: the impacts of Early Head Start. Available at: www.mathematica-mpr.com/publications/pdfs/ehsfinalvol1.pdf. Accessed September 1, 2015
79. Paulsell D, Avellar S, Sama Martin E, Del Grosso P. *Home Visiting Evidence of Effectiveness Review: Executive Summary*. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, US Department of Health and Human Services; 2010
80. Lundahl B, Risser HJ, Lovejoy MC. A meta-analysis of parent training: moderators and follow-up effects. *Clin Psychol Rev*. 2006;26(1):86–104
81. McMenamy J, Sheldrick RC, Perrin EC. Early intervention in pediatrics offices for emerging disruptive behavior in toddlers. *J Pediatr Health Care*. 2011;25(2):77–86
82. Chang SM, Grantham-McGregor SM, Powell CA, et al. Integrating a parenting intervention with routine primary health care: a cluster randomized trial. *Pediatrics*. 2015;136(2):272–280
83. Glascoe FP, Trimm F. Brief approaches to developmental-behavioral promotion in primary care: updates on methods and technology. *Pediatrics*. 2014;133(5):884–897
84. Mendelsohn AL, Huberman HS, Berkule SB, Brockmeyer CA, Morrow LM, Dreyer BP. Primary care strategies for promoting parent-child interactions and school readiness in at-risk families: the Bellevue Project for Early

Language, Literacy, and Education Success. *Arch Pediatr Adolesc Med*. 2011;165(1):33–41

85. Needlman R, Toker KH, Dreyer BP, Klass P, Mendelsohn AL. Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. *Ambul Pediatr*. 2005;5(4):209–215

86. Mendelsohn AL, Dreyer BP, Flynn V, et al. Use of videotaped interactions during pediatric well-child care to promote child development: a randomized, controlled trial. *J Dev Behav Pediatr*. 2005;26(1):34–41

87. Mendelsohn AL, Valdez PT, Flynn V, et al. Use of videotaped interactions during pediatric well-child care: impact at 33 months on parenting and on child development. *J Dev Behav Pediatr*. 2007;28(3):206–212

88. Klein MD, Alcamo AM, Beck AF, et al. Can a video curriculum on the social determinants of health affect residents' practice and families' perceptions of care? *Acad Pediatr*. 2014;14(2):159–166

89. Bogin J. Enhancing developmental services in primary care: the Help Me Grow experience. *J Dev Behav Pediatr*. 2006;27(suppl 1):S8–S12, discussion S17–S21, S50–S52

90. Roux AM, Hererra P, Wold CM, Dunkle MC, Glascoe FP, Shattuck PT. Developmental and autism screening through 2-1-1: reaching underserved families. *Am J Prev Med*. 2012;43(6 suppl 5):S457–S463

91. AAP Council on Community Pediatrics. Poverty and Child Health in the United States. *Pediatrics*. 2016;137(4). Available at: www.pediatrics.org/cgi/content/full/137/4/e20160339

Predictors of Poor School Readiness in Children Without Developmental Delay at Age 2

Bergen B. Nelson, Rebecca N. Dudovitz, Tumaini R. Coker, Elizabeth S. Barnert, Christopher Biely, Ning Li, Peter G. Szilagyi, Kandyce Larson, Neal Halfon, Frederick J. Zimmerman and Paul J. Chung

Pediatrics 2016;138;
DOI: 10.1542/peds.2015-4477 originally published online July 18, 2016;

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/138/2/e20154477
References	This article cites 79 articles, 25 of which you can access for free at: http://pediatrics.aappublications.org/content/138/2/e20154477.full#ref-list-1
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): **Developmental/Behavioral Pediatrics** http://classic.pediatrics.aappublications.org/cgi/collection/development:behavioral_issues_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: https://shop.aap.org/licensing-permissions/
Reprints	Information about ordering reprints can be found online: http://classic.pediatrics.aappublications.org/content/reprints

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Predictors of Poor School Readiness in Children Without Developmental Delay at Age 2

Bergen B. Nelson, Rebecca N. Dudovitz, Tumaini R. Coker, Elizabeth S. Barnert, Christopher Biely, Ning Li, Peter G. Szilagyi, Kandyce Larson, Neal Halfon, Frederick J. Zimmerman and Paul J. Chung

Pediatrics 2016;138;
DOI: 10.1542/peds.2015-4477 originally published online July 18, 2016;

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/138/2/e20154477