



## **Project Report**

### **Early Childhood Predictors of Early School Success: A Selective Review of the Literature**

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**Abstract (word count: 106)**

There is a long-standing lack of integration between the fields of child development and health and health services research. In this brief, we review scientific evidence from all these literatures as they relate to early school readiness, focusing on results from large longitudinal studies. The review does not cover the substantial literature in these areas based on small sample studies. We intend that the results will provide a foundation for research that may lead to the development of practical clinical tools allowing health caregivers to identify young children at risk for early school performance problems, and target them for additional preventive and ameliorative care leading to improved outcomes.

## **Introduction**

Early child health and development provide the foundation from which children can extend themselves to engage in increasingly more challenging activities that stimulate their physical, cognitive, and social development. Promoting optimal child health and development, particularly in the early years, is, therefore, important not only for children's current health and development, but also for their future.<sup>1,2</sup> Early school success is clearly related to success in adulthood.<sup>3,4</sup> From a life course perspective, investing in improving early school success by nurturing children's adaptability---promoting resilience factors while reducing risks--is both worthwhile and cost-effective.<sup>5-</sup><sup>7</sup> Identifying critical risk and resilience factors is the first step in developing interventions to promote early school success.

Recognizing the importance of promoting health and development during childhood, child health professionals devote considerable attention to health supervision services. Health supervision is the bedrock of early childhood preventive care. It comprises age-appropriate counseling about health and normative developmental changes, vaccination to promote immunologic resilience, support given to families as they face the challenges of child rearing, early detection of disorder and developmental delay, and promotion of healthful child behaviors. Over the past 20 years, there has been a strong movement to strengthen child health supervision. *Bright Futures*<sup>6</sup> and *Healthy Steps*<sup>8</sup> are prominent examples of such efforts.

Remarkably, there have been few attempts to integrate the science of risk and resilience during early childhood with health supervision services. Although *Bright Futures* recommends that "more frequent visits may be indicated for children at increased risk because of medical and/or social concerns,"<sup>6</sup> health professionals are offered only vague guidance on how to identify these at-risk children and families. Our inability to conduct needs assessment of children and families according to their risk of poor future health and developmental outcomes has resulted in formulaic provision of services and uniform payment for services despite differences in children's health profiles. If an index that assessed a child's clinical risk and health assets were available to clinicians, then it could be used to separate children into different groups requiring distinct levels of preventive

service. Although such a risk assessment tool would be used primarily to guide clinical service provision, it is likely that if the tool were widely adopted, payment policy for child health care could be revised to adjust for different levels of care provision.

Researchers have produced a rich scientific base on the risks and assets that are predictive of such critical outcomes as readiness to learn in school,<sup>9-11</sup> successful coping in school settings,<sup>12</sup> and child health and well-being.<sup>13</sup> Although this work has produced a long list of predictors of early school success, none has ranked the relative importance of various risk and resilience factors in predicting early school success. Determining relative strength could guide researchers in selecting a finite set of factors to inform a brief, clinical risk index. To fill this gap in the literature, we conducted a focused, 2-tiered literature review to catalog the scientific evidence for factors that predict early school success prior to entry and to assess the relative strength of these factors, a particular focus on results from large-scale longitudinal studies. We also assessed whether predictors of early school success could be obtained from parental report because this would facilitate implementation in the clinical setting.

### **Guiding Conceptual Framework**

The framework guiding our review of risks and assets is based on a model originally adopted by the National Education Goals Panel,<sup>14</sup> and subsequently refined in the work of Zaslow et al.<sup>15</sup> and Brown et al.<sup>2</sup> The framework has several distinctive features:

- **Focus on the whole child.** Readiness extends to include all aspects of physical, social, emotional, and intellectual development that is related to early school success. This is in contrast to more conventional approaches focusing narrowly on intellectual development. There is a strong body of research to back this broader approach.
- **Developmental.** Every age group within 0-5 (infancy, early childhood, etc.) has its own markers and developmental milestones appropriate to that developmental stage.
- **Ecological.** It recognizes the importance of family, early child care, early health care, as well as neighborhood and community characteristics in shaping the development that leads to or detracts from early school success.

The developmental/ecological nature of this model has its origins in the child development literature as represented in the work of Bronfenbrenner,<sup>16</sup> and has been widely adopted in early development and school readiness research.<sup>9, 15, 17</sup> This basic approach was adapted by Brown et al.<sup>2</sup> to emphasize the role of preventive and ameliorative health care in the developmental process, which is a primary focus of our current project. A more elaborated version of this model is presented in **Figure 1** (attached).

We focused on predictors in early childhood for several reasons. First, identification of factors in early childhood presents opportunities for early intervention to promote school success. Second, as previously stated, early school success is highly predictive of later school success. Third, contact between pediatricians and families is greatest in the first two years of life.<sup>18</sup> Finally, we believe identifying early childhood predictors may lead to the development of innovative risk assessment tools that can be applied in clinical settings to better tailor preventive services to the needs of each individual child.

## **Methods**

We conducted a structured two-tiered literature review that began with 14 major reviews focusing on specific domains of school readiness (e.g., emotional health, language, etc.) or risks/assets as the primary source documents. From these articles, we used a “snowball” approach whereby other references were identified from reference lists of the fourteen articles and examined for relevance to this review. In addition, we used a major search engine to identify any other relevant articles using key words associated with general risks and outcomes, such as “risk”, “resilience”, “cognitive achievement”, and “school readiness.” All types of studies, including observational studies, were included in our review.

From the articles we identified in this first tier, we then selected articles based on the criteria detailed in **Table 1**. In this stage, our goal was to move beyond identifying potential factors and to gauge the relative strength of early predictors of school success. We limited this review to longitudinal studies that measured one or more of the predictors of early school success prior to school entry, and to studies with large sample sizes. A

structured

abstraction form

was used to

evaluate the articles.

The form recorded

citation, description

and size of sample,

**Table 1. Inclusion criteria for articles**

1. Sample size greater than 500, and *not* limited to a specific group by design (e.g., only children of a specific race, poverty level, or program)
2. Measured 1 or more of the predictors of early school success among children prior to school entry
3. Longitudinal studies with initial assessment prior to school entry and with follow-up at least 6 months later
4. Follow-up at age 54 months (4.5 years) or beyond
5. Assessment of cognitive capacity or academic achievement at follow-up
6. Articles published during or after 1980.

predictors examined and measurement properties (i.e., validity and reliability, when available), covariates examined, and effect size (for those with the exposure and those without). Because of the complexities of comparing effect sizes across review articles, we created an additional table that ranks each predictor's strength based on its relative effect size, outcome, accompanying controls, and consistency in strength across studies.

Through this approach, each predictor was assigned one of five possible rankings, including strong, moderate, weak, mixed, not significant, and no evidence in review's second tier. Additional details on methods are presented in **Appendix A**.

### **Measures of Early School Success**

Early school success has been construed to assess various dimensions of child health and well-being, including physical and emotional health, behavior, cognition, and language.<sup>15</sup>

In this review, we limited the definition of school success to academic achievement and intellectual capacity in order to focus our efforts. It is important to note that limiting our definition of early school success to cognitive outcomes influenced the choice of predictors under examination. Additional details on measures of early school success used in this review are presented in **Appendix B**.

### **Risk and Asset Measures of Early School Success**

In conducting this review, we speculated that risk and resilience factors predicting early school success would fall into the following five broad categories: 1) sociodemographic characteristics (e.g., family income, maternal age, maternal education, etc.); 2) prenatal and childhood medical problems (e.g., low birthweight, chronic conditions such as asthma, developmental delays, etc.) ; 3) behavior problems, including mental health problems; 4) the social environment (e.g., parenting, child care type, drug/alcohol

exposure); and 5) neighborhood conditions (e.g., unemployment rates, social capital, etc.). We also expected factors would differ in general prevalence among children at different ages and in relative strength of association with early school success. In determining whether factors confer risk or are assets, we considered those factors associated with outcomes below the mean as conferring risk and those factors associated with outcomes above the mean as assets. Note that some factors, such as maternal education, can be considered risks or assets depending on the specific status of that factor (i.e. less than high school vs. college graduate).

## **Results**

### *Evidence from large, longitudinal studies of early school success is limited*

Of the 250 articles that were identified in our search, only 25 satisfied all literature review selection criteria. Most articles examined multiple risks and assets and were conducted on relatively small populations (e.g.,  $\leq 250$ ). Studies with larger sample sizes were usually observational and often included children outside the pre-specified age groups for this review. Longitudinal studies often had smaller samples and/or spanned a shorter time period than our age criteria required (e.g., from birth to 24 months). Other studies were excluded based on our age criteria. Examples and brief descriptions of some seminal articles that, due to our selection criteria, were excluded in our review are provided in **Appendix C**.

### *Socio-demographic characteristics are strong predictors of early school success*

We found strong effects between early school success, maternal education, family income, gender, and birthweight (**Table 2**). The literature contained moderate evidence for a positive relationship between early school success and select factors in the social environment (i.e. drug/alcohol exposures, maternal affect) and prematurity. There was weak evidence that early school success was positively related to many factors in the social environment. Mixed evidence was found for several sociodemographic characteristics, including race/ethnicity, family size and structure, as well as maternal affect and prenatal alcohol exposure. We found no evidence for effects between school success and any neighborhood conditions—though this may reflect that this association has been closely examined only within the last five years.

Findings from our review indicate that both social and biological factors across various domains of child well-being are predictive of early school success. Most individual effect sizes are modest. However, it is likely that the cumulative effect of multiple risk factors may be highly predictive of early school success. A number of studies have found that the accumulation of risk is substantially more predictive than that of any single factor,<sup>19, 20</sup> which suggests that developing a risk index that combines these and other predictors could have substantial predictive value.

*Further research is needed to identify additional predictors of early school success*

The first tier of our review uncovered many potentially promising predictors of school success. These factors, however, were often evaluated in small or observational studies or were predictive of an outcome related to academic achievement, such as behavioral or emotional well-being. Predictors that appeared promising but did not meet our criteria included additional measures from each of our four conceptual domains—including additional sociodemographic characteristics, receipt of recommended pediatric care, nutrition, early literacy skills, motor skills, externalizing behavior, family conflict, reading to children, child care attendance, and neighborhood conditions (See “Other potentially important factors in the literature” in Table 2). Further research is needed to determine whether these factors are predictive of school-aged cognitive achievement when measured in early childhood and whether these results can be generalized to other children.

<b>Table 2. Predictors of Early School Success</b>	
<b>Strong</b>	<ul style="list-style-type: none"> <li>○ Maternal Education<sup>21-26</sup></li> <li>○ Gender<sup>22, 26-31</sup></li> <li>○ Income<sup>21, 23, 26-29, 32-34</sup></li> <li>○ LBW<sup>22, 25, 26, 28, 29, 31, 33, 35-37</sup></li> </ul>
<b>Moderate</b>	<ul style="list-style-type: none"> <li>○ Prematurity<sup>29, 31</sup></li> <li>○ Prenatal cigarette exposure<sup>27, 28, 37</sup></li> <li>○ Maternal affect<sup>31, 32</sup></li> </ul>
<b>Weak</b>	<ul style="list-style-type: none"> <li>○ Maternal age<sup>22, 25, 27-29</sup></li> <li>○ Parental cognitive Ability<sup>27, 28</sup></li> <li>○ Maternal warmth<sup>38</sup></li> <li>○ Maternal sensitivity<sup>21</sup></li> <li>○ Punitive parenting<sup>38</sup></li> <li>○ Television<sup>39</sup></li> <li>○ Prenatal Care<sup>25, 27</sup></li> <li>○ Early hospitalization<sup>33</sup></li> <li>○ Second-hand smoke<sup>28, 31</sup></li> </ul>
<b>Mixed</b>	<ul style="list-style-type: none"> <li>○ Race/ethnicity<sup>22, 26-28, 30, 33</sup> (mostly strong, but weak/NS when introduce a high number of controls)</li> <li>○ Family structure<sup>22, 26, 29, 30</sup> (mixed, mostly strong)</li> <li>○ Family size<sup>26, 30, 31</sup> (two studies are moderate to strong, one study not accounting for family structure is mixed)</li> <li>○ Prenatal alcohol exposure<sup>28</sup> (mixed - weak to moderate for reading &amp; NS for math)</li> </ul>
<b>Other potentially important factors in the literature</b>	<ul style="list-style-type: none"> <li>○ <i>Sociodemographics</i>: parental literacy, parental health literacy, birth intervals, immigrant status, English proficiency, parental employment</li> <li>○ <i>Prenatal/childhood medical problems</i>:             <ul style="list-style-type: none"> <li>▪ <i>Health care</i>: appropriate pediatric care, appropriate immunizations</li> <li>▪ <i>Nutritional deficits</i>: failure to thrive, underweight, iron deficiency</li> <li>▪ <i>Early special medical care/chronic conditions</i>: visual ability, ear infections, low APGAR</li> <li>▪ <i>Development</i>: early language and literacy skills, cognitive ability, developmental disability, motor skills, deafness, speech defects</li> </ul> </li> <li>○ <i>Behavior and personality characteristics</i>: internalizing and externalizing behavior, social functioning, attention, self-regulation, affect, temperament</li> <li>○ <i>Social environment</i> <ul style="list-style-type: none"> <li>▪ <i>Prenatal environment</i>: maternal mental health, unintended pregnancy</li> <li>▪ <i>Home environment</i>: lead exposure, family conflict, number of books, reading to children</li> <li>▪ <i>Parenting</i>: attachment, developmental and educational expectations, exposure to speech</li> <li>▪ <i>Child care</i>: type, provider ratio, provider education, classroom features, accreditation, hours</li> </ul> </li> <li>○ <i>Neighborhood conditions</i>: poverty, affluence, male joblessness, safety</li> </ul>

## **Conclusions**

Contrary to popular perceptions, many of the factors identified in the research literature as predictive of school success are drawn from studies with a small sample or sample limited to a specific group. Few risk factors, and even fewer assets, are drawn from large-scale, representative, longitudinal studies that are capable of simultaneously assessing multiple early influences on subsequent school readiness. We found the strongest evidence for effects between school success and maternal education, family income, low birthweight, and gender. While information on all of these factors is easily obtained from parental report, elucidating the mechanism by which these factors affect school success is one of the most persistent and challenging problems in the literature. However, it is important to note that these same factors have been repeatedly shown to have effects on child health and well-being that sustain into adulthood.<sup>29, 37</sup> Though we found no evidence for effects of health care on early school success in this review, this may be a reflection of the lack of integration between the fields of child development and health services research.

From the outset, we acknowledged that there were many studies demonstrating the importance of other risks and assets (e.g., reading to children, number of books in the home, etc.) related to school success that did not meet our criteria for review. Though it is likely that these factors do relate to early school success, the evidence supporting the effects of these factors has been established through observational studies or small scale studies. Researchers may be interested in conducting large scale longitudinal studies to further establish and expand the evidence for these relationships.

There are, of course, several caveats to this review. First, we focused this review on the cognitive dimension of early school success. A great deal of work has examined other dimensions of school success and can inform future research efforts. Second, we focused on early childhood predictors. As children grow and develop, the relative importance of these predictors may change. Additional research in this area is needed.

### *Implications for clinicians*

For practicing clinicians, early school success is often monitored during routine health supervision visits in an unstructured, informal manner despite being one of the most critical indicators of child well-being. If an index-based screener that assessed a child's likelihood of school success early in life were available to clinicians, it could be used to sort the population into different preventive service levels. Clinicians routinely judge patients' severity of illness and other health risk factors to determine the mix and intensity of services that should be applied on an individual basis to promote optimal health outcomes. For example, the NHLBI asthma severity groups (mild intermittent, mild persistent, moderate persistent, and severe persistent) sort patients from lowest to highest asthma severity level and influence the intensity of follow-up, pharmacologic interventions, and the use of subspecialty services.<sup>40, 41</sup> Because school success depends on optimal health, this same model could be applied in healthcare settings to promote academic achievement.

From a treatment perspective, separating patients into different service intensity levels is also commonplace in clinical practice. Disease and care management programs use statistical models based on diagnoses and prior use information to forecast which patients

will have the greatest need and demand for services. These scores are used to stratify, or “tier,” the intensity level of care management interventions, which results in the highest risk patients (typically top 0.5-5% risk scores) being contacted by nurse care managers as frequently as multiple times each week and moderate risk levels (typically top 5-10% risk scores) less frequently (e.g., once a week), while lower risk patients receive routine care.

Services to promote healthy development and well-being leading to better school outcomes could be provided not only by physicians but also by nurses, social workers, community-based service organizations, or other health professionals as deemed appropriate. For example, several types of therapeutic responses may be indicated for high risk children, such as:

- Further developmental screenings using standardized instruments to identify at risk children, which could lead to early intervention services;
- More comprehensive and frequent needs assessments using standardized measures of development and behavior;
- Referral to social service or community-based organizations for family support services;
- Health supervision visits at more frequent intervals than recommended by the American Academy of Pediatrics;
- Longer health supervision visits, which may be required to optimize parental health literacy;
- Multi-disciplinary visits that could include a combination of nurse, physician, and other health professional encounters during the same visit;
- Nurse home visits; and

- Periodic telephone calls.

In summary, the strongest predictors of early school success established in the literature are socio-demographic characteristics easily obtained from parental report. Further research, however, is needed to explore the predictive value of factors that did not meet this study's criteria but that appear promising. Developing an instrument to identify at-risk children using these factors in the clinical setting is a critical step in integrating research on child development into clinical practice. Ultimately, adoption of this type of instrument in the clinical setting may improve our ability to ensure optimal child health and well-being in the long-term.

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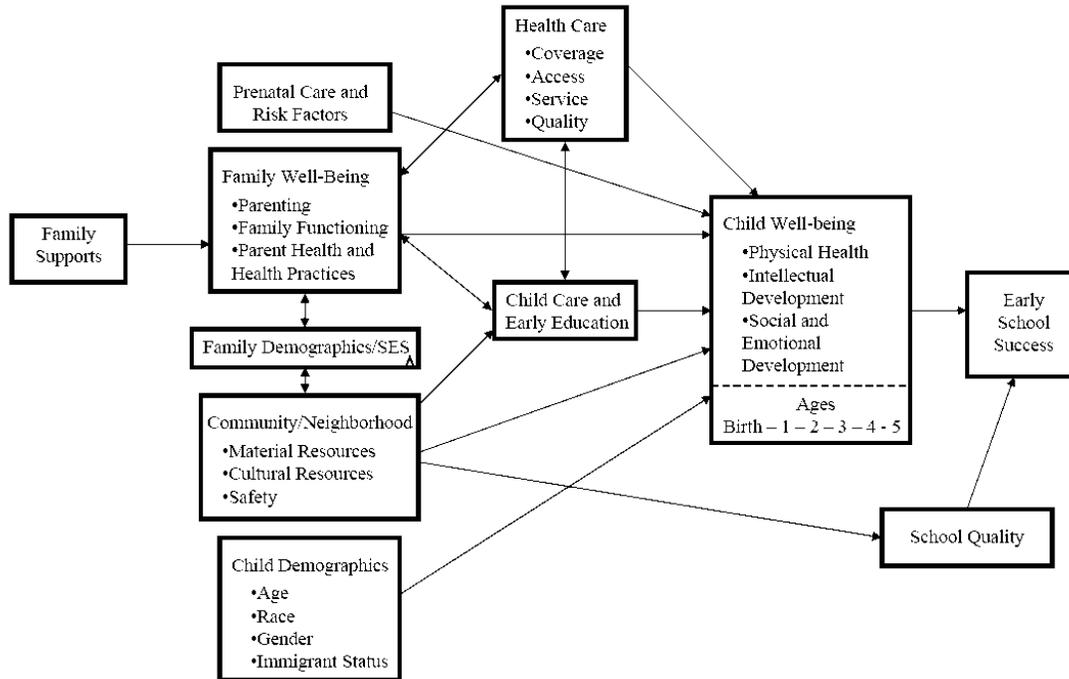
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**Figure 1**

Model of Early Childhood Development Leading to Early School Success



**Appendix A. Two-Tiered Selection of Articles/Data Extraction**

1<sup>st</sup> Tier – Because there have been several excellent reviews cataloging correlates of school success, we began the literature review using fourteen major reviews that focused on specific domains of school readiness (e.g., emotional health, language, etc.) or risks/assets as the primary source documents. From these articles, we used a “snowball” approach whereby other references were obtained from reference lists of the fourteen articles and examined for relevance to this review. From each article identified, references were again reviewed for topic relevance. In addition, we used a major search engine to identify any other relevant articles using key words associated with general risks and outcomes, such as “risk”, “resilience”, “cognitive achievement”, and “school readiness.” All types of studies, including observational studies, were included in our review.

2<sup>nd</sup> Tier – From the articles we identified in the 1<sup>st</sup> Tier, we then selected articles based on the criteria detailed in **Table 1**. To ensure relevance to the primary question, we included only articles that measured one or more of the predictors of early school success among pre-school children. We also included only studies with large sample sizes primarily to identify factors with relatively high prevalence and to avoid problems of limited generalizability or unstable estimates. Finally, we limited our definition of school success to the cognitive dimension, including intellectual capacity or academic achievement.

A structured abstraction form was used to evaluate the articles. The form recorded citation, description and size of sample, predictors examined and measurement properties (i.e., validity and reliability, when available), covariates examined, and effect size (for those with the exposure and those without). Because of the complexities of comparing effect sizes across each review article, we created an additional table that ranks each predictor’s strength based on its relative effect size, outcome, accompanying controls, and consistency in strength across studies. Each predictor was assigned one of five possible rankings, including strong, moderate, weak, mixed, not significant, and no evidence.

Owing to the small number of studies reporting odds ratios or risk ratios, the ranking process often involved relative comparisons of regression coefficients. For example, **Table 3** demonstrates the ranking process where

**Table 3. Ranking of Predictors**

Rank	Predictor Scale (# of categories)	Outcome Scale (# of items in range)	Beta
<b>Strong</b>			
	2-3 (e.g., gender; LBW)	50+ (e.g., PIAT)	≥ 2.5-3.0
	8-15 (e.g., edu; income in 10,000's)	50+ (e.g., PIAT)	≥ 0.4
	30+ (e.g., income in 1,000's)	50+ (e.g., PIAT)	≥ 0.1
<b>Moderate</b>			
	2-3	50+ (e.g., PIAT)	1.0-2.0
	8-15	50+ (e.g., PIAT)	0.1-0.3
	30+	50+ (e.g., PIAT)	0.02-0.05
<b>Weak</b>			
	Anything below moderate that was still significant		

Notes: Ranges are **approximate**; outliers were included in the category closest to the listed score/range

the outcome scale (e.g., PIAT score) contains a range of 50 or more possible categories and the predictor scale ranges from 2 categories to 30 or more categories. For outcomes with a narrower range than the PIAT, smaller regression coefficients were given greater weight in determining relative ranking.

We ranked predictors in this manner in order to identify factors with potential utility in developing interventions to improve early school success as well as utility in developing interventions to provide enhanced health care services to at-risk children and families. By identifying at-risk children and families, the current one-size-fits-all approach to pediatric health supervision could be transformed to provide tiered levels of services tailored to the specific needs of at-risk populations.

### **Appendix B. Measures of Early School Success**

Measures of early school success used in the literature include measures of academic performance, such as grade retention, and measures of cognitive readiness to learn, such as scores on various instruments. The two most widely used instruments in the literature are the Peabody Individual Achievement Test (PIAT) and the Peabody Picture Vocabulary Test (PPVT). The PIAT is a wide-range measure of academic achievement for children over age five that assess reading, mathematics, and spelling within the child's range of difficulty. Though its primary purpose is to evaluate students referred for special education, it is among the most widely used brief measures of academic achievement in the literature and requires only a pointing response for most items. It was revised from the original version developed by Lloyd Dunn and Frederick Markwardt in 1970 and renormed in 1995-1996.<sup>42, 43</sup> We describe the components of the PIAT included in this literature review. The PIAT Reading Recognition assessment consists of 100 items that measure recognition of printed letters and the ability to read words aloud. The PIAT Reading Comprehension assessment consists of 82 items where the child chooses one of four pictures that best illustrates a sentence. The PIAT Mathematics assessment consists of 100 multiple choice items beginning with early skills such as recognizing numerals and progressing to measuring advanced concepts in geometry and trigonometry. Standardized scores have a mean of 100 with a standard deviation of 15.

The PPVT is designed primarily to measure receptive vocabulary of standard American English for children over aged 2.5 and allows verbal and non-verbal responses. Originally published in 1959, it was revised in 1981 to improve reliability and discriminating capability.<sup>44, 45</sup> The child is shown four pictures while the examiner says a single stimulus word; the child then verbally or non-verbally indicates which picture best represents the stimulus word. Standardized scores have a mean of 100 with a standard deviation of 15.

Additional measures of early school success reported in the literature include the Poor Infant Index (newly developed teacher assessment of literacy, math, social behavior, and independent learning developed in the United Kingdom), Bracken School Readiness Assessment,<sup>46</sup> Reynell Developmental Language,<sup>47</sup> Griffith's Mental Developmental Scales,<sup>48</sup> and the Woodcock-Johnson Scales<sup>49</sup> - these scales are described in **Table 4**.

<b>Table 4. Additional Measures of Early School Success</b>	
<b>Bracken School Readiness Assessment</b>	<ul style="list-style-type: none"> <li>○ Used to determine if a child has an underlying language disorder</li> <li>○ Designed for children from ages 2 through 7</li> <li>○ Includes six subtests from the <i>Bracken Basic Concept Scale-Revised</i> (BBCS-R)               <ul style="list-style-type: none"> <li>▪ Colors, Letters, Numbers/Counting, Sizes, Comparisons, and Shapes</li> </ul> </li> </ul>
<b>Reynell Developmental Language Scales</b>	<ul style="list-style-type: none"> <li>○ Used to determine language skills in young or developmentally delayed children</li> <li>○ Designed for children from ages 1 through 6</li> <li>○ Includes 2 scales:               <ul style="list-style-type: none"> <li>▪ Verbal Comprehension Scale – assesses receptive language skills and can be used for children who can respond orally or only by pointing</li> <li>▪ Expressive Language Scale – assesses expressive language skills using 3 sets of items: structure, vocabulary, and content</li> </ul> </li> </ul>
<b>Griffith's Mental Development Scales</b>	<ul style="list-style-type: none"> <li>○ Used to measure rates of development that are significant for intelligence or indicative of mental growth in infants and young children</li> <li>○ Designed for children from ages 0 through 8 years</li> <li>○ Includes 2 scales, some items are shared by both scales:               <ul style="list-style-type: none"> <li>▪ Scale 1 – for ages 0-2, includes 27 items</li> <li>▪ Scale 2 – or ages 2-8 , includes 22 items</li> </ul> </li> </ul>
<b>Woodcock-Johnson Scales</b>	<ul style="list-style-type: none"> <li>○ Used to measure levels of achievement in reading, mathematics, written language, and knowledge</li> <li>○ Designed for ages 2 to 90+</li> <li>○ Includes 4 Categories of tests:               <ul style="list-style-type: none"> <li>▪ Reading Tests – organized into 3 clusters (Broad Reading, Basic Reading Skills, and Reading Comprehension) and measure reading achievement and vocabulary</li> <li>▪ Mathematics Tests – organized into 3 clusters (Broad Mathematics, Basic Mathematics Skills, and Mathematics Reasoning) and measure abilities to calculate and solve word problems</li> <li>▪ Written Language Tests – organized into 3 clusters (Broad Written Language, Basic Writing Skills, and Written Expression) and measure abilities to produce single-word responses and complex sentences, and identify and correct spelling, punctuation, capitalization, and usage errors.</li> <li>▪ Broad Knowledge Tests – measures knowledge of general content areas, rather than specific skills</li> </ul> </li> </ul>

<b>Appendix C. Examples/Brief Descriptions of Seminal Articles Excluded Due to Criteria</b>	
<p><b>Samples of Less Than 500 Participants</b></p>	<ul style="list-style-type: none"> <li>○ Scarborough HS. Preschool literacy experience and later reading achievement. <i>Journal of Learning Disabilities</i>. Oct 1991;24(8):508-511.</li> <li>○ Christian K, Morrison FJ, Bryant FB. Predicting kindergarten academic skills: Interactions among child care, maternal education, and family literacy environments. <i>Early Childhood Research Quarterly</i>. 1998;13(3):501–521.</li> </ul>
<p><b>Measured Outcomes Earlier Than Age 4</b></p>	<ul style="list-style-type: none"> <li>○ Klebanov PK, Brooks-Gunn J, McCarton C, McCormick MC. The contribution of neighborhood and family income to developmental test scores over the first three years of life. <i>Child Development</i>. Oct 1998;69(5):1420-1436.</li> <li>○ To T, Cadarette SM, Liu Y. Biological, social, and environmental correlates of preschool development. <i>Child: Care, Health and Development</i>. Mar 2001;27 (2):187-200.</li> </ul>
<p><b>Measured Predictors Older Than Age 3</b></p>	<ul style="list-style-type: none"> <li>○ Judge S. Resilient and vulnerable at-risk children: Protective factors affecting early school competence. <i>Journal of Children &amp; Poverty</i>. Sep 2005;11(2):149-168.</li> <li>○ Pianta RC, Nimetz SL, Bennet E. Mother-child relationships, teacher-child relationships and school outcomes in preschool and kindergarten. <i>Early Childhood Research Quarterly</i>. 1997;12(3):263–280.</li> </ul>
<p><b>Examined School Readiness and Related Outcomes Other Than Cognitive Achievement</b></p>	<ul style="list-style-type: none"> <li>○ Dearing E, McCartney K, Taylor BA. Change in family income-to-needs matters more for children with less. <i>Child Development</i>. Nov-Dec 2001;72(6):1779-1793.</li> <li>○ Murray A, Yingling J. Competence in language at 24 months: Relations with attachment security and home stimulation. <i>Journal of Genetic Psychology</i>. Jun 2000;161(2):133-140.</li> <li>○ Beck JE, Shaw DS. The influence of perinatal complications and environmental adversity on boys' antisocial behavior. <i>Journal of Child Psychology and Psychiatry</i>. Jan 2005;46(1):35-46.</li> </ul>
<p><b>Limited to Specific Populations (e.g. welfare dependents, Head Start participants, or low-income respondents)</b></p>	<ul style="list-style-type: none"> <li>○ Parker FL, Boak AY, Griffin KW, Ripple C, Peay L. Parent-child relationship, home learning environment, and school readiness. <i>School Psychology Review</i>. 1999;28(3):413-425.</li> <li>○ Currie J, Neidell M. Getting inside the “black box” of Head Start quality: What matters and what doesn't. <i>Economics of Education Review</i>. Feb 2007;26(1):83-99.</li> </ul>