Development of a Brief Screening Tool for Early Literacy Skills in Preschool Children

Sai Iyer, MD; Diana Do, MPH; Natacha Akshoomoff, PhD; Vanessa L. Malcarne, PhD; Kate Hattrup, PhD; Susan P. Berger, PhD; Sheila Gahagan, MD, MPH; Robert Needlman, MD

From the Developmental-Behavioral Pediatrics, Department of Pediatrics, University of California (S Iyer), Los Angeles; Graduate School of Public Health, San Diego State University (D Do); Department of Psychiatry, University of California, San Diego (N Akshoomoff); Department of Psychology, San Diego State University (VL Malcarne and K Hattrup); Department of Pediatrics, University of California, San Diego (S Iyer and S Gahagan), San Diego, Calif; Department of Pediatrics, Northwestern University Feinberg School of Medicine (SP Berger), Chicago, Ill; and Department of Pediatrics, MetroHealth Medical Center, CaseWestern Reserve University (R Needlman), Cleveland, Ohio
The authors have no conflicts of interest to disclose.
Address correspondence to Sai Iyer, MD, Developmental-Behavioral Pediatrics, Department of Pediatrics, University of California, Los Angeles, 300 Medical Plaza Building, Suite 3300, Los Angeles, CA 90095 (e-mail: siyer@mednet.ucla.edu).

ABSTRACT

BACKGROUND: Preschool children develop early literacy skills (ELS) needed for reading acquisition. Screening for delayed ELS could trigger interventions to prevent reading problems.

OBJECTIVE: To develop a brief screening test for ELS delays, the Early Literacy Skills Assessment Tool (ELSAT).

METHODS: This study included 4-year-old, typically developing, English language−predominant children attending preschool. The ELSAT comprised 63 items relating to 3 main ELS domains and was piloted with 21 children. After we excluded items that were nondiscriminatory, 57 items remained and were administered to 96 children. Items were compared with reference measures of ELS (Get Ready to Read−Revised), and language (Peabody Picture Vocabulary Test-4 and Phonological Awareness from the Comprehensive Test of Phonological Processing-2). Within-domain reliability was calculated for each of the 3 ELS domains and item correlations between all ELSAT items and the reference measures were calculated.

RESULTS: A final set of 10 items was retained that represented all 3 ELS domains and that maximized correlations with reference measures. Cronbach alpha for the refined 10-item ELSAT was 0.868; correlations between individual items and a composite of the reference measures ranged from 0.409 to 0.617 (all Ps < .01). In a receiver operating characteristic curve analysis, a cut-off score of ≤5 predicted a below-average score for any of the reference measures with sensitivity of 90%, specificity of 71.4%, and area under the curve of 0.872.

CONCLUSIONS: The 10-item ELSAT shows strong psychometric properties and with further validation may prove valuable in screening preschool children for ELS delays.

KEYWORDS: literacy; preschool; primary care; reading; screening

ACADEMIC PEDIATRICS 2019;19:464−470

WHAT'S NEW

In this study, we present a brief 10-item screening tool to identify early literacy delays in preschool children with strong psychometric properties when compared with standard measures of language and early literacy.

LEARNING TO READ is an important milestone of the early school years. Children develop early (emergent) literacy skills during preschool that are predictive of their later reading success.[1] The term "emergent literacy skills" refers to the skills, knowledge, and attitudes that children have about reading and writing before they begin formal instruction.[2] Factors associated with a child's later reading abilities include oral language, alphabet knowledge, phonological processing abilities, and print knowledge.[3,4]

Children display varying levels of emergent literacy skills at kindergarten entry.[5] Factors that influence the development of these skills include aspects of the home literacy environment, such as availability of developmentally appropriate books and learning materials and how often parents read aloud to their children.[6] Access to quality preschool education also plays an important role.[7] Children growing up in poverty[8] and in families with lower levels of parental education[9] are more likely to show delayed early literacy skills (ELS) than are children from more advantaged homes.

Approximately 40% of children enter kindergarten 1 or more years behind their peers.[5] This gap widens over time, and many children do not catch up to their peers.[10] It is far more expensive to attempt remediation of these delays than to identify delays early enough to offer appropriate intervention.[11]

In preschool children, the development of ELS strongly predicts later reading success.[3] Valid ELS assessment tools

are available to identify children with delays but are used in select early educational settings and therefore are not accessible to children who do not attend such preschools.[12] Early identification of emergent literacy delays offers an opportunity for effective, targeted intervention before school entry, resulting in improved scholastic outcomes.[13]

The American Academy of Pediatrics recommends developmental screening using evidence-based measures at 9, 18, and 30 months.[14] At present, there is no recommendation for routine developmental screening of preschool children. Early literacy screening at the 4-year-old preschool visit would enable universal identification of children with early literacy delays. In a previously published study, we described the development and validation of a 5-item parent questionnaire to screen preschool children for later reading problems.[15,16] We also showed that use of general developmental screeners, such as the Ages and Stages Questionnaire and the Survey of Well Being in Young Children, miss preschool children who have a delay in ELS.[17] In our sample, parents of 51% of the children who passed the Ages and Stages Questionnaire and 39% of those who passed the Survey of Well Being in Young Children had concerns about their child's ELS.

Parent questionnaires, although very useful and practical, may be affected by demand characteristics, and the parents of children who are at greatest risk of early delays may avoid using these tools because of their own limited literacy skills and the strong stigma associated with illiteracy.[18]

The conceptual model informing this work is depicted in Figure 1. Children begin to develop ELS in the preschool period that are predictive of their reading success in third grade.[19] The home literacy environment influences the development of oral language skills as well as ELS.[6] Access to quality preschool education is also an important factor in the development of ELS.[7] Awareness of print concepts, letter knowledge, and phonological awareness have been identified as important predictors of reading success.[2] Print concepts and phonological awareness, along with oral language, have been associated with later word-decoding abilities.[2] Many pediatric practices engage in literacy promotion in primary care, as recommended by the American Academy of Pediatrics.[14] This serves as primary prevention by encouraging parents to read aloud to their children and by providing good-quality, age-appropriate books to the children. Literacy promotion also can have a role in
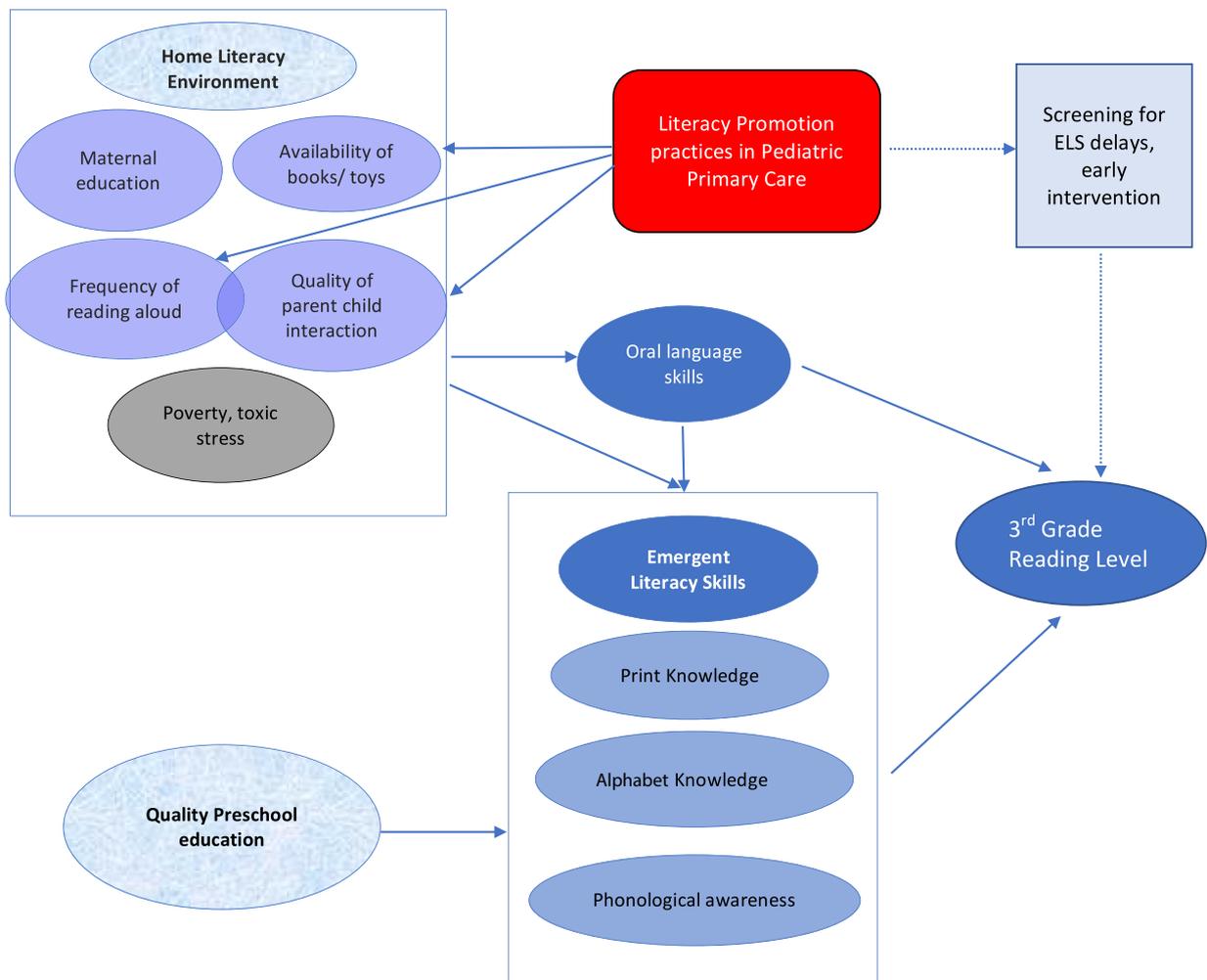

Figure 1. *Conceptual model – literacy development. ELS indicates early literacy skills.*

secondary prevention through screening and early identification of literacy delays.

Print concepts include knowledge of the letters of the alphabet as well as awareness of the conventions of print. Alphabet knowledge at the time of school entry has been shown to be one of the strongest predictors of later reading abilities.[20,21] Familiarity with print conventions (orientation of print from left to right, top to bottom, knowing where the words are on a page, recognizing the function of the letters on the page) appears to be important in learning to read.[22] Phonological awareness refers to the ability to manipulate the sound structure of oral language.[23] Children who can detect and manipulate the sounds within words and identify rhymes learn to read faster than others.[24] The aim of this study was to develop a brief screening tool for use with preschool children that assesses the 3 main domains of ELS, using a shared book interaction.

METHODS

STUDY SAMPLE

Participants were typically developing, 4-year-old children enrolled in preschool (either Head Start or 1 of 2 private preschools) whose families were predominantly English-speaking. Written informed consent was obtained from the parents or caregivers.

Approval for the study was obtained from the institutional review board at the University of California, San Diego. Additional approvals were obtained from the Neighborhood House Association of San Diego (Head Start) and 2 private preschools. The study was conducted in 2 phases, as outline in the sections to follow.

TEST DEVELOPMENT AND PILOT PHASE

A preliminary version of the Early Literacy Skills Assessment Tool (ELSAT) included 63 items related to 3 main domains of ELS, namely Print Concepts and Word Awareness, Alphabet Knowledge, and Phonological Awareness. Phonological Awareness in turn comprises 3 subdomains: Letter-Sound Association, Rhyming, and Word Segmentation.

A standard picture book was chosen for the study (*Max & Ruby's Treasure Hunt* by Rosemary Wells). The choice of the book was made in consultation with a children's librarian and based on developmental appropriateness, perceived level of interest to 4-year-old children, and suitability for the early literacy domains being studied.

We first administered a preliminary version of the ELSAT with 63-items to 21 children (14 in Head Start, 7 in a private preschool). The goal of this phase was to determine ease of administration of the items and the children's ability to understand and answer the questions. At the end of this phase, items that were either answered correctly or incorrectly by >90% of the sample were excluded, leaving 57 items that were retained in the ELSAT for the next phase.

VALIDATION PHASE

During this phase, children (Head Start and 2 private preschools) were tested using the 57-item ELSAT as well as 3 reference measures, the Peabody Picture Vocabulary Test-4, a measure of receptive language[25]; the Get-Ready to Read Revised[26]; and Comprehensive Test of Phonological Processing-2 (Elision, Blending words, Sound matching subtests),[27] as measures of early literacy. Parents also were asked to fill out a demographic questionnaire and were compensated with a $10 gift card. Children in the Head Start preschools completed the assessments during the Spring 2015, and children from the 2 private preschools completed them during the Summer 2015.

PROCEDURE

The children were tested individually in a separate room in their preschools. The 57-item ELSAT was administered to all the children by a single trained examiner. A second trained examiner administered the 3 reference measures. The examiners did not provide any direct feedback or praise to the children during the testing, except for occasional reminders to stay on task as needed. The testing was completed in a single sitting and lasted approximately 20 minutes. Children were given a sticker when they completed the testing.

STATISTICAL ANALYSIS

Within-domain reliability between the items for each of the domains was calculated using the Cronbach alpha. correlations of individual ELSAT items, and each of the 3 reference measures also were computed. Composite domain scores were computed and correlations between these scores and each of the 3 reference measures were calculated.

In the interest of creating the briefest possible measure, we further refined the ELSAT. Items that had the greatest correlation coefficient with all 3 reference measures were retained, resulting in a 10-item measure. Correlation coefficients and Cronbach alpha for the refined tool were calculated.

Scores from the final 10-item ELSAT were then correlated with a simple equally weighted linear composite of the reference measures, created to represent a "gold standard." For the purpose of estimating the screening characteristics of the ELSAT, we considered the gold standard to be "positive" if the standard score on any of the 3 reference measures fell below average (ie, a score <90 on the Comprehensive Test of Phonological Processing-2, <90 on the Get-Ready to Read Revised, or <85 on the Peabody Picture Vocabulary Test-4). Receiver operating characteristic curves were generated and corresponding sensitivities and specificities and area under the curve (AUC) were calculated for different cut-off scores on the ELSAT.

RESULTS

The validation phase included a total of 96 preschool children (Head Start = 61, private preschool = 35). There was no significant difference in age ($P = .28$, independent t test) or sex ($P = .7$, Chi-square) between the 2 groups

(Table 1). There was a greater frequency of white children in the private preschool group than in the Head Start group (67% vs 25%, Chi-square = 12.023, $P < .01$) and more children of Hispanic ethnicity in the Head Start group than in the private preschool group (41% vs 7%, Chi-square = 9.725, $P < .01$).

Figure 2 shows comparisons between the performance of the children in the 2 groups (Head Start and private

Table 1. Demographic Data

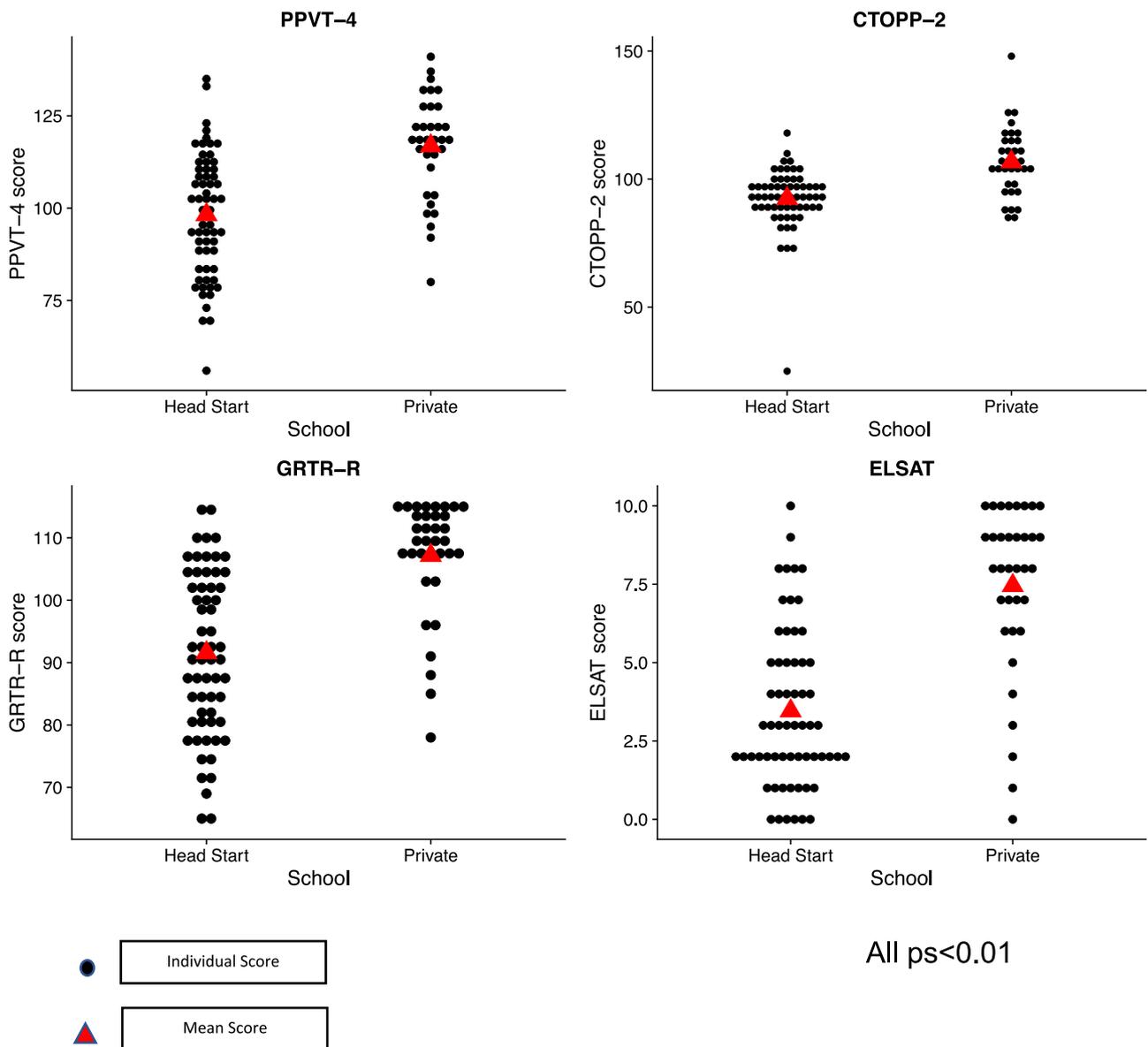|	Head Start (n = 61)	Private Preschool (n = 35)
Age, mo, mean (SD)	54 (4.8)	53 (3.8)
Sex, male	43%	43%
Race		
White	25%	67%
African-American	7%	4%
Asian	11%	15%
Mixed	25%	15%
Other	32%	0%
Ethnicity		
Hispanic/Latino	41%	7%
Percentage who speak languages other than English at home	32%	21%

Figure 2. Distribution of scores in Head Start and Private Preschools for all the measures. PPVT-4 indicates Peabody Picture Vocabulary Test, 4th edition; CTOPP-2, Comprehensive Test of Phonological Processing, 2nd edition; GRTR-R, Get Ready to Read, Revised; and ELSAT, Early Literacy Skills Assessment Tool.

preschool) for each of the reference measures and for the ELSAT. The mean scores of the private preschool group were significantly greater (t test, $P < .01$) for each of the reference measures compared with the Head Start group. The mean ELSAT score was also significantly greater (t test, $P < .01$) for the private preschool group (mean = 8.09, standard deviation = 2.75) compared with the Head Start group (mean = 3.67, standard deviation = 2.48).

Table 2 shows the correlations between reference measures and the 57 ELSAT items, grouped within the predetermined domains, along with the Cronbach alpha scores for the item domain groups. Items in the domains of Print Concepts and Word Awareness, Alphabet Knowledge, and Phonological Awareness were highly correlated with the reference measures, and the domains had strong Cronbach alpha scores.

Table 3 shows the items on the final 10-item ELSAT along with correlations of the items with a composite of the reference measures formed by simple unit-weighted average of standardized scores on the 3 measures. The Cronbach alpha of the 10-item ELSAT was 0.87. The 10-item ELSAT showed significant correlations in the expected directions with each of the 3 reference measures as well as with the composite of the 3 reference measures (Table 4).

Receiver operating characteristic curves were generated for different cut-off scores on the ELSAT that would predict a "below-average" score on any of the reference measures (Figure 3). AUC, sensitivities, and specificities for different scores were calculated to identify the ideal cut-off score. A cut off score of ≤5 predicted a below-average score in the composite of reference measures with sensitivity of 90% and specificity of 71.43%, with AUC being 0.87.

DISCUSSION

Identification of early literacy delays can be a valuable addition to developmental screening in pediatric primary care. The 10-item ELSAT, developed in this study, is a valid screening tool to identify delays in ELS in 4-year-old children. The ELSAT is composed of items related to domains of ELS that are important for later reading development, namely print concepts, phonological awareness, and oral language skils.[28] The items chosen for the ELSAT maintain representation of the important components of these ELS. The 10 items on the ELSAT are highly correlated with reference measures of receptive language and early literacy, suggesting that this a valid measure of these ELS.

There were significant differences in the performance of children from Head Start schools when compared with children from private schools in all of the reference

Table 2. Within-Domain Correlation of ELSAT Items

Domain Composite Score, n = 96	Pearson Correlation			Cronbach Alpha
	PPVT-4	GRTR-R	CTOPP-2	
Print Concepts & Word Awareness (PCWA) (15 items)	0.56*	0.64*	0.45*	0.78
Alphabet Knowledge (AK) (14 uppercase, 10 lowercase)	0.58*	0.79*	0.42*	0.96
Phonological Awareness (PA)	0.60*	0.69*	0.57*	0.92
Letter Sound Association (LS) (9 items)	0.56*	0.63*	0.54*	
Rhyming (RH) (3 items)	0.37*	0.56*	0.37*	
Word Segmentation (WS) (4 items)	0.54*	0.54*	0.45*	

ELSAT indicates Early Literacy Skills Assessment Tool; PPVT-4, Peabody Picture Vocabulary Test, 4th edition; GRTR-R, Get Ready to Read, Revised; and CTOPP-2, Comprehensive Test of Phonological Processing, 2nd edition.
*P< .01.

Table 3. Final 10-Item ELSAT

| Final 10-Item ELSAT		ELSAT Correlation With Composite of Reference Measures (Pearson Correlation)
	Domain: Print Knowledge & Word Awareness	
Show me the name of the book.		0.49*
Which line do I read last?		0.41*
	Domain: Letter knowledge	
What is this letter?	R	0.60*
	Y	0.62*
	s	0.54*
	m	0.62*
	Domain: Phonological Awareness	
Letter Sound Association	What sound does this letter make (point to H)?	0.59*
	What sound does this letter make (point to S)?	0.58*
Rhyming	What word rhymes with "stout?"	0.46*
Word Segmentation	Say the word "downstairs" without saying "down"	0.62*

ELSAT indicates Early Literacy Skills Assessment Tool.
*Correlation is significant at <.01 level.

Table 4. Correlations of 10-Item ELSAT

	Pearson Correlation			
	PPVT	GRTR-R	CTOPP-2	Composite of Reference Measures
Refined 10-item ELSAT	0.69*	0.76*	0.57*	0.81*

ELSAT indicates Early Literacy Skills Assessment Tool; PPVT-4, Peabody Picture Vocabulary Test, 4th edition; GRTR-R, Get Ready to Read, Revised; and CTOPP-2, Comprehensive Test of Phonological Processing, 2nd edition.
*P < .01.
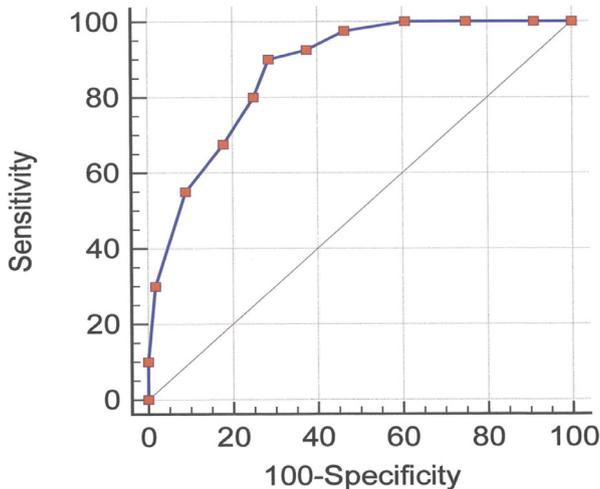
Figure 3. *Receiver operating characteristic curve.*

measures as well as the ELSAT (Figure 2). Our findings are similar to other studies that have shown significant differences in language and literacy in children growing up in poverty. Without focused intervention, many of these children are likely to struggle to learn to read and to fall behind their more advantaged peers. Hart and Risley, in their landmark 1995 study, demonstrated large social class differences in children's exposure to language.[29] They showed that children from the lowest social classes are exposed to 30 million fewer words by the age of 3 years, compared with children from the highest classes. Similar differences also have been shown in ELS. Data from the National Center for Educational Statistics show that among 3- to 5-year-old children, only 10% of those living in poverty were able to recognize all the letters of the alphabet, compared with 28% of those not living in poverty. In addition, only 19% of children living in poverty showed 3 or more signs of emerging literacy, whereas 45% of children not living in poverty did so.[30]

Other studies have shown differences in alphabet knowledge between children from middle- and lower-income families. Four-year-old children from middle-income families knew an average of 54% of letter names, whereas children from lower-income families knew only 4 letters on average at entry into a Head Start or similar program and learned an additional 5 letters while enrolled in the program.[31]

All the children in our study were enrolled in a preschool program; however, this is not true of most young children. In a 2015 report, for example, only 48% of preschool-age children whose parent had professional degrees attended preschool, and this percentage was even lower (29%) among children of parents with less formal schooling (high school or less).[32] Therefore, a system that relied on screening for literacy delays in preschool would likely miss more than one half of children and an even greater percentage of those who are at risk for reading problems. These data highlight the importance of screening for early literacy delays in pediatric primary care, which may be the only avenue for such screening for most children.

Screening for ELS in preschool children can lead to early detection and intervention for these delays. The 10-item ELSAT can be completed in approximately 1 to 2 minutes and could potentially be used as part of the 4-year-old preventive care visit. It can be combined with other literacy promotion practices, such as the Reach Out and Read interaction,[33] serving both as primary prevention as well as screening. The ELSAT is easy to administer, requires minimal training, and can be done either by the clinician or other clinic staff.

LIMITATIONS AND NEXT STEPS

This study has a few limitations that should be noted. The findings are not yet generalizable to other populations, given that the sample size was small and limited to children attending preschool. Children from non−English-speaking families were not included. Further validation with larger and more diverse populations and longitudinal follow-up to determine predictive validity are necessary next steps. Furthermore, we used item statistics to identify a subset of efficient items, and some loss of generalizability may occur as a result. However, our choice of items in the final ELSAT measure was based substantially on content validity, by identifying an optimal set of items from a priori content domains that were also empirically supported in our analyses. Feasibility and acceptability of the ELSAT in pediatric practices should also be studied in follow-up research.

CONCLUSIONS

The 10-item ELSAT is a validated measure showing robust correlations with each of 3 reference measures for language and early literacy. The ELSAT has the properties of a good screening tool-with a cut off score of ≤5 predicting a below-average score in any one of the reference measures with good sensitivity and acceptable specificity.

ACKNOWLEDGMENTS

REFERENCES

1. Teale WH, Sulzby E. *Emergent Literacy: Writing and Reading.* Norwood, NJ: Ablex Publishing Corporation; 1986.

2. Whitehurst GJ, Lonigan CJ. Child development and emergent literacy. *Child Dev.* 1998;69:848–872.

3. Lonigan CJ, Burgess SR, Anthony JL. Development of emergent literacy and early reading skills in preschool children: evidence from a latent-variable longitudinal study. *Dev Psychol.* 2000;36:596–613.

4. Lonigan CJ, Schatschneider C, Westberg L. *Identification of Children's Skills and Abilities Linked to Later Outcomes in Reading, Writing, and Spelling.* Washington, DC: National Institute for Literacy; 2008.

5. West J, Denton K, Germino-Hausken E. *America's kindergartners.* Washington, DC: National Center for Education Statistics; 2000.

6. Roberts J JJ, Burchinal M. The role of home literacy practices in preschool children's language and emergent literacy skills. *J Speech Lang Hear Res.* 2005;48:345–359.

7. Wong VC, Cook TD, Barnet WS, et al. An effectiveness-based evaluation of five state prekindergarten programs. *J Policy Anal Manage.* 2008;27:122–154.

8. Shonkoff J. *From Neurons to Neighborhoods: The Science of Early Child Development.* Washington, DC: National Academy Press; 2000.

9. Fowler MG, Cross AW. Preschool risk factors as predictors of early school performance. *J Dev Behav Pediatr.* 1986;7:237–241.

10. Juel C. Learning to read and write: a longitudinal study of 54 children from first through fourth grades. *J Educ Psychol.* 1988;80:437–447.

11. Fielding L, Kerr N, Rosier P. *Annual Growth for All Students: Catch-up Growth for Those Who Are Behind.* Kennewick, WA: New Foundation Press; 2007.

12. Whitehurst GJ. *The NCLD Get Ready to Read Screening Tool Technical Report.* Arlington, VA: National Center for Learning Disabilities; 2003.

13. Bailet LL, Repper KK, Piasta SB, et al. Emergent literacy intervention for prekindergarteners at risk for reading failure. *J Learning Disabil.* 2009;42:336–355.

14. Council on Early ChildhoodHigh PC, Klass P. Literacy promotion: an essential component of primary care pediatric practice. *Pediatrics.* 2014;134:404–409.

15. Iyer SN, Sawyer MI, Germany M, et al. Development of a 5-item parent questionnaire to screen preschool children for reading problems. *Clin Pediatr.* 2014;53:571–578.

16. Iyer SN, Sawyer MI, Lambert G, et al. Validation of a Five-Item Parent Questionnaire to Screen Preschool Children for Reading Problems. *Clin Pediatr.* 2016;55:492–495.

17. Iyer SN, Dawson MZ, Sawyer MI, et al. Added value of early literacy screening in preschool children. *Clin Pediatr.* 2017;56:959–963.

18. Parikh NS, Parker RM, Nurss JR, et al. Shame and health literacy: the unspoken connection. *Patient Educ Couns.* 1996;27:33–39.

19. Lonigan CJ. Development, assessment, and promotion of pre-literacy skills. *Early Educ Devel.* 2006: 91–114.

20. Adams MJ. *Learning to Read: Thinking and Learning About Print.* Cambridge, MA: A Bradford Book; 1990.

21. Scarborough HS. *Early Identification of Children at Risk for Reading Disabilities: Phonological Awareness and Some Other Promising Predictors.* Hillsdale, NJ: Eribaum; 1998.

22. Clay MM. *The Early Detection of Reading Difficulties.* 3rd ed. Portsmouth, NH: Heinemann; 1979.

23. Torgesen JK, Wagner RK, Rashotte CA. Longitudinal studies of phonological processing and reading. *J Learning Disabil.* 1994;27:276–286; discussion 287−291.

24. Bradley L, Bryant P. *Rhyme and Reason in Reading and Spelling.* Ann Arbor, MI: University of Michigan Press; 1985.

25. Dunn LM, Dunn, DM. *Technical Report, Peabody Picture Vocabulary Test. 4th edition.* 2013. Available at: http://images.pearsonassessments.com/images/assets/ppvt-4/2013-ppvt-tech-rpt.pdf. Accessed June 1, 2018.

26. Lonigan C, Wilson SB. *Report on the Revised Get Ready to Read! Screening Tool: Psychometrics and Normative Information.* New York: National Center for Learning Disabilities; 2008.

27. Wagner RK, Torgesen JK, Rashotte CA, et al. *Comprehensive Test of Phonological Processing-Second Edition (CTOPP-2).* Austin, TX: PRO-ED; 2014.

28. Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, DHHS. *(Developing Early Literacy: Report of the National Early Literacy Panel (NA).* Washington DC: National Institute for Literacy; 2010.

29. Hart B, Risley TR. *Meaningful Differences in the Everyday Experience of Young American Children.* Baltimore, MD: Paul H. Brookes Publishing Co.; 1995.

30. Nord CW, Lennon J, Liu B, et al. *Home Literacy Activities and Signs of Children's Emerging Literacy: 1993 and 1999 (NCES 2000−026).* Vol 76. Washington DC: US Department of Education; 1999.

31. Dickinson DK, Neuman SB. *The Roots of Learning to Read and Write: Acquisition of Letters and Phonemic Awareness.* Vol 2. New York: Guilford Press; 2006.

32. McFarland J, Hussar B, de Brey C, et al. The Condition of Education 2017. 2017. Available at: https://nces.ed.gov/pubs2017/2017144.pdf. Accessed May 25, 2018.

33. Needlman R, Fried LE, Morley DS, et al. Clinic-based intervention to promote literacy. A pilot study. *Am J Dis Child.* 1991;145:881–884.