

Screening for Low Literacy Among Adult Caregivers of Pediatric Patients

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Background and Objectives: *The association between functional illiteracy and poor health has led to pediatric literacy promotion programs in the primary care setting. These interventions do not address linked parental literacy needs. An obstacle to referring adults to literacy services is the lack of an instrument that can efficiently identify individuals who could benefit from such programs. We sought to identify screening items sufficiently simple to use in clinical practice.* **Methods:** *This cross-sectional study examined 98 adult primary caregivers of preschool children seen in an inner-city primary care setting. Literacy level and 17 variables predicted to be associated with low literacy were assessed.* **Results:** *Three items were independently associated with a \leq 6th grade reading level: (1) <12th grade completion, (2) not living with the child's other parent, and (3) not reading for pleasure. Receiver operating characteristic (ROC) curve analysis indicates that, used together, these variables have discriminant capacity, with an area under the ROC curve of .76.* **Conclusions:** *Three items for use in a simple screening instrument for parental low literacy were identified. Used together, they had favorable characteristics but must be further tested for generalizability.*

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Low literacy skill among adults is highly prevalent,¹ has significant implications for the health care system,² and is independently associated with poor health status.³⁻⁶ Because of the strong link between health and literacy, health care providers have developed literacy programs for children.^{8,9} Illiteracy does not exist in isolation, however, but represents an intergenerational phenomenon, with parental illiteracy greatly increasing the risk of reading difficulty among children.⁷ Interventions for children that are based in physicians' offices do not address the needs of low literacy adults in the family (parents or other primary caregivers). This is significant because interventions that target both child and adult literacy skills, rather than just the children's skills, may lead to improved school preparedness as well as to cognitive stimulation and emotional support for children.^{10,11}

To target literacy interventions at parents, it is necessary for physicians to recognize adults with low lit-

eracy skill, and physicians' inability to do this is an obstacle to referring adults to literacy enhancement programs.¹² An efficient screening tool for the medical setting would enable providers to identify adults who have limited literacy skills and then recommend interventions to enhance their literacy skills.

Existing literacy screening tools that can be incorporated into busy clinical practice are limited in number and take at least 1–2 minutes to administer.^{13,14} We felt that even these minimal requirements represent significant obstacles to incorporating screening into clinical practice. We sought, therefore, to develop a simpler instrument modeled on the four-item CAGE questionnaire used to identify adults at risk for alcohol abuse or dependence.^{15,16} This study's objective was to test items for use in a simple CAGE-type screening tool to identify adults with increased risk of low literacy skill among primary caregivers of preschool children seen in a primary care setting.

Methods

Study Sample

This cross-sectional study involved 98 adults who identified themselves as the primary caregiver of preschool children (<age 6 years) being seen by family

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physicians and pediatricians at three health care centers of the Philadelphia Department of Public Health. The study sample size (100 targeted) was based on the estimated national percentage of adults with functional illiteracy (20%) to ensure adequate numbers of low-literacy adults for analysis.¹ Centers were chosen with relatively homogeneous demographic populations—namely, African American, poor, and English-speaking persons.

Subjects were enrolled consecutively while waiting for a visit with the physician and after giving consent to participate. Subjects were selected during clinical sessions that were chosen to provide an equal representation across morning, afternoon, and evening sessions, as well as different weekdays at the three study sites over the course of 6 weeks. The Philadelphia Department of Public Health Institutional Review Board reviewed and determined that this study was exempt from formal review.

Instruments

Interviews of 3–5 minutes were carried out to explore three domains: (1) literacy activity at home (Table 1, items 1–6), (2) the literacy skill of the respondent,

and (3) responses to 11 additional items hypothesized a priori to be related to parental literacy skill (Table 1, items 7–17). All questions were administered orally and recorded by a single interviewer.

BABAR. The interviews began with administration of the Before and After Books and Reading (BABAR) instrument, developed by the National Reach Out and Read program.¹⁷ This well-accepted and short (1–2 minutes) instrument was designed to be used for measuring changes in literacy orientation and self-reported activity at home before and after the initiation of Reach Out and Read programs (pre and post intervention). The questionnaire includes a combination of open-ended and short-answer items (Table 1, questions 1–8). Item 7 was dichotomized into <12th grade completion and ≥12th grade school completion for analyses.

REALM. Literacy of the adult respondents was measured with the Rapid Estimate of Adult Literacy in Medicine (REALM) instrument.¹³ This instrument has been used with demographic groups similar to those in the present study and is well accepted by participants.¹⁸ The REALM provides raw scores as well as four grade-

Table 1

Items Asked of Adult Caregivers of Preschool Children and Their Measured Association With the Low Literacy Category*

Item and Response Tested for Statistical Association	P Value
1. What are your three favorite things to do with (child's name) these days? No, if does not mention "read" or "book."	.271
2. What do you do to help prepare (child's name) for sleep at night? No, if does not mention "read" or "book."	.373
3. Is there anything you do with (child's name) now that will help him/her be successful when he/she goes to first grade? No, if does not mention "read" or "book."	.893
4. Do you ever read children's books to (child's name)? Or is she/he too young for that? No.	.336
5. How many books altogether do you have at home that you read to (child's name)? Number.	.336
6. How many days each week do you read children's books to (child's name)? Number.	.343
7. How many years of school have you completed? <12th grade.	.000**
8. Did you ever get a book for your child from a doctor or encouragement to read aloud? Yes.	.070**
9. Do you have any other children? No.	.172**
10. What is your age? Number.	.248**
11. If parent, does your child's other parent live with you? No.	.043**
12. Are you employed? No.	.309
13. Do you ever read books for fun? No.	.016**
14. Do you ever buy newspapers to read? No.	.055**
15. If yes to the previous question, do you buy them daily? No.	.512
16. Do you have a library card? No.	.459
17. Does the child seen today in the office have a library card? No.	.053**

* (≤6th grade reading level). Responses were coded based on the interpretation that they were literacy promoting or not for analysis. Items 1–8 from BABAR instrument.¹⁴

** Tested in forward stepwise multivariate analysis

Bold—significant association between low literacy category and not-literacy-promoting response are in bold ($P < .05$).

P values determined by two-sided *t* test or χ^2 analysis as appropriate.

equivalence categories (<4th grade, 4th–6th grade, 7th–8th grade, and 9th grade and higher), which focus on discriminating levels of low literacy skill.

Additional Items. We asked a set of nine additional items predicted to be associated with literacy skill (Table 1, questions 9–17). These questions were about employment, demographic characteristics, and reading interest. To subjects with limited literacy skills, we asked the additional questions “Do you think your reading could be better?” and “Would you be interested in getting help with your reading?”

Data Analysis

Literacy level as determined by REALM score (gold standard) was dichotomized by splitting the sample into low (≤ 6 th grade) and high (> 6 th grade) literacy levels. This level was chosen based on the significant difficulty that adults with less than a 7th grade reading level have with the majority of medical instructional materials.¹⁹ Associations between literacy level and independent variables were then determined using two-sided *t* test or χ^2 analysis based on whether they were continuous or categorical variables, respectively. Candidate variables for a predictive instrument were selected in two independent manners and then compared (1) by testing for the presence of a significant association with the low literacy category ($P < .05$) and (2) through a conditional stepwise multiple regression modeling procedure that included all variables having a modest association ($P < .25$) with the low literacy category (Table 1; entry level set at .05 and removal set at .10). The independence of variables chosen for the predictive instrument was analyzed through subsequent multiple regression analysis.

Receiver operating characteristic (ROC) curve analysis was used to evaluate the discrimination capacity of the resultant predictive test or its ability to accurately identify those individuals in the dichotomized categories (low and high literacy groups).²⁰ ROC curves plot sensitivity (true positive ratio) by 1-specificity (true negative ratio) for a series of thresholds established by responses to the instrument items (the plotted points on the graph). These thresholds provide information regarding the test characteristics that can be used to determine the relative usefulness of the test and the specific threshold that maximizes the desired characteristics for a specific clinical setting (emphasizing either the sensitivity or specificity of the instrument). The area under the ROC curve (AUROC) represents an overall measurement of performance of the screening test, with 1.0 a perfect test and .5 representing a test with no discriminating capacity.²¹

All statistical analyses were carried out using the SPSS® version 10 or STADA® (version 7.0; confidence intervals for sensitivity and specificity measures) software. For these analyses, we used a level of statistical

significance set at $\alpha = .05$, recognizing that tests of statistical significance are approximations that serve as aids to interpretation and inference.

Results

Demographic data for the sample group are summarized in Table 2. Most respondents were African American (90.6%) and mothers (86.3%), with a mean age of 29.5 years. Their children had a mean age of 32.9 months. Two parents (both African American mothers) refused to participate but raised no objections to the study or its subject. Raw REALM scores and the four grade-range equivalents indicate that 35.7% of respondents had ≤ 6 th grade reading level and so were included in the low literacy group (0–3rd grade=9.2%, 4th–6th grade=26.5%, 7th–8th grade=32.7%, and ≥ 9 th grade=31.6%). Among subjects with limited literacy, 91% recognized a reading deficiency, and 83% were interested in being referred to a literacy program.

Three items (items 7, 11, and 13 on Table 1) were identified as candidate screening items by virtue of their statistically significant associations with low literacy ($P < .05$). Independently, eight variables included in a stepwise multivariate analysis based on modest association with the low literacy category ($P < .25$; items 7–10, 13, 14, and 17) generated four that were significantly associated with the low literacy category (items 7, 8, 11, and 13, data not shown). Item 8—responding yes to the question “Did you ever get a book for your child from a doctor or encouragement to read aloud?”—was discarded because it was not felt to be suitable as a

Table 2

Demographics of Adult Respondents and Their Children

<i>Variable</i>	
Age in years (mean \pm SD)	29.5 \pm 10.4
Years of school completed (mean)	11.1 \pm 1.8
Relationship to child (#, %)	
Mother	82 (86.3)
Father	8 (8.4)
Grandparent	5 (5.3)
Parents living separately (#, %)	62 (60.8)
Other parent involved in parenting (#, %)	70 (77.0)
Employed (#, %)	53 (54.1)
Ethnic group (#, %)	
African American	89 (90.8)
Other	9 (9.1)
Child age in months (mean \pm SD)	32.9 \pm 22.4

SD—standard deviation

screening item. Thus, both approaches identified items 7, 11, and 13 for possible use in a screening instrument.

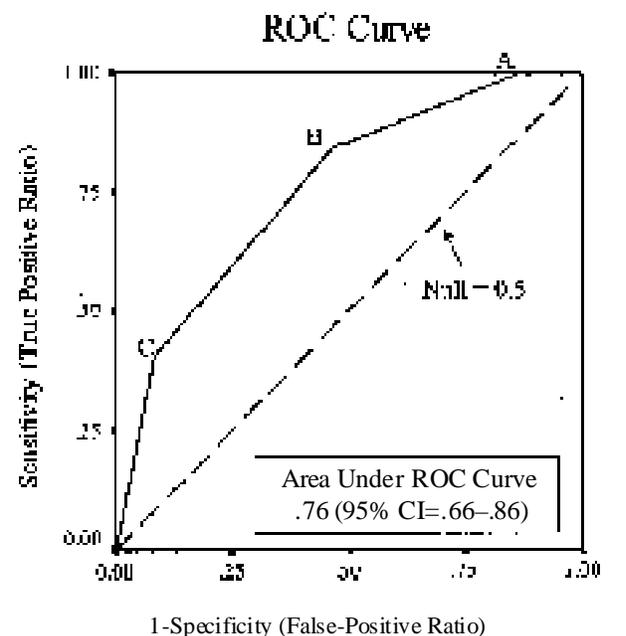
Univariate (non-adjusted) analysis determined that three items were significantly associated with low literacy (Table 3): (1) less than 12th grade completion (item 7, OR=2.63, 95% CI=1.02–6.77), (2) responding no to the question “Is your child’s other parent living with you?” (item 11, OR=5.30, 95% CI=5.11–13.11), and (3) responding no to the question “Do you ever read books for fun?” (item 13, OR 3.05, 95% CI=1.20–7.75). Multivariate (adjusted) analysis indicated independence of these associations, controlling for each other. After adjustment, the point estimate for item 13 was essentially unchanged, although with some loss of precision.

ROC curve analysis indicated that the three-item instrument had an AUROC of .76 (Figure 1), which was significantly greater than the null value of .5 ($P<.001$, 95% CI=.66–.86). The sensitivities with 95% CIs of the three-item prediction rule were 1.00 (.89–1.00), .84 (.67–.95), and .40 (.24–.59) for one, two, or three positive (at-risk) responses, respectively, while their specificities were .14 (.06–.25), .54 (.40–.66), and .92 (.82–.97). Positive predictive values for each, using the observed prevalence of <7th grade literacy of .36%, were .38 (.28–.49), .49 (.35–.63), and .72 (.47–.90), while negative predictive values were 1.0 (.63–1.0), .86 (.71–.96), and .74 (.63–.84). Removal of any one of these items greatly reduced the test characteristics of the instrument (data not shown).

Discussion

In this study of 98 adult primary caregivers of preschool children, we identified three items that can be used as a simple screening tool to identify patients likely

Figure 1
ROC Curve Analysis of a Three-item Instrument to Screen for Low Literacy Among Adult Caregivers



Cut Points	Sensitivity (95% CI)	Specificity (95% CI)	PV+ (95% CI)*	PV (95% CI)**
A=1/2	1.00 (.89–1.00)	.13 (.06–.25)	.38 (.28–.49)	1.00 (.63–1.00)
B=2/3	.84 (.67–.95)	.53 (.40–.63)	.49 (.35–.63)	.86 (.71–.96)
C=3	.41 (.24–.59)	.92 (.82–.97)	.72 (.47–.90)	.74 (.63–.84)

* Positive predictive value (prevalance ≤6th grade reading level=.36)
** Negative predictive value

Confidence intervals are 95% (except when point estimate=1, then 97.5 and one sided), calculated using the binomial exact method.

Table 3

Univariate (Non-adjusted) and Multivariate (Adjusted) Logistic Analysis of the Association of Three Variables and ≤6th Grade Literacy Level

Independent Variable	Non-adjusted OR (95% CI)	Adjusted OR (95% CI)
Is your child’s other parent living with you? “No”	2.63 (1.02–6.77)	3.84 (1.30–11.35)
Completed <12th grade of school	5.30 (5.11–13.11)	4.91 (1.77–13.62)
Do you ever read books just for fun? “No”	3.05 (1.20–7.75)	2.86 (.97–8.39)

OR—odds ratio
CI—confidence interval

to have literacy skills at or below the 6th grade level. The questions (1) “How many years of school have you completed?” (2) “Is your child’s other parent living with you now?” and (3) “Do you ever read books for fun?” had discriminant capacity for identifying adults with low literacy skill (AUROC of .76).

The CAGE questionnaire has been widely used to identify adults at risk for alcohol abuse or dependence in the primary care setting.^{16,22} The success of this simple four-item questionnaire lies in its ease of use. The sensitivity and specificity of the CAGE using the standard two-question cutoff has been reported to be from 73%–81% and 89%–

96%, respectively, with AUROCs ranging from .76–.8423. The overall performance of our instrument is comparable to the CAGE but has higher sensitivity and lower specificity.

As shown in Figure 1, the sensitivity and specificity of this instrument range from 1.00–.41 and .13–.92 based on the number of at-risk responses. This means that while all adults with low literacy skill would be identified if only one at-risk response is used to identify a case, 87% of those identified would actually be of higher literacy. We recommend that a two-question cutoff point (the minimum number of positive screening responses needed to identify an adult at risk for low literacy) be used for this instrument, with sensitivity of .84 and specificity of .56, as it appropriately balances the costs of false positives with the risks of false negatives. This cutoff point would result in detection of 84% of adults with low literacy but with 46% of the low literacy risk group being incorrectly screened (actually with higher literacy).

The positive predictive value (PPV) or the probability that someone with positive responses actually is in the low literacy group, is dependent on the prevalence of a trait. In this sample with a prevalence of \leq 6th grade literacy of 35.7%, the PV for a two-item cutoff point is .49 (95% CI=.35–.63). While the PPV would be lower in a sample with lower rates of low literacy skill, this prevalence rate is consistent with that seen nationally for poor minority populations, and rates higher than observed here have been reported among parents of African American children in pediatric care.^{1,19} Based on the negative predictive value (NPV) of the three-item instrument, anyone with no positive responses is unlikely to fall in the low literacy category (NPV=1.0, 95% CI=.63–1.0).

Limitations

This study was limited to a demographically homogeneous population comprised primarily of poor, African American women from an urban setting. This sample was chosen because it represents an at-risk demographic group both for low literacy skill and poor health status, but the generalizability, or the ability of an instrument to predict accurately in a new sample, of this instrument remains to be shown. Despite these limitations, this study presents important initial evidence that a simple screening tool can be developed for use in the clinical setting, at least in a population with high risk of low literacy skill.

We envision this instrument as a tool to aid in the identification of adults with increased risk of low literacy skill (as well as identify those with very low risk) so that adult literacy services may be targeted more efficiently. This instrument should not be considered a diagnostic tool of illiteracy but rather as a means of initial risk stratification to be followed by an offer of services.

Conclusions

The results of this study indicate that a simple screening test for adult illiteracy, similar to the CAGE questionnaire, can be developed for use in a clinical practice setting. A major challenge for the future will be to improve the discriminant capacity of this or related instruments by identifying additional variables that can be added to or replace items evaluated here. The development and validation of such an instrument will greatly enhance the ability of practitioners to address literacy needs among the adult caregivers of children.

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