Maternal Literacy and Associations Between Education and the Cognitive Home Environment in Low-Income Families

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Objective: To determine whether maternal literacy level accounts for associations between educational level and the cognitive home environment in low-income families.

Design: Analysis of 369 mother-infant dyads participating in a long-term study related to early child development.

Setting: Urban public hospital.

Participants: Low-income mothers of 6-month-old infants.

Main Exposure: Maternal literacy level was assessed using the Woodcock-Johnson III/Bateria III Woodcock-Munoz Tests of Achievement, Letter-Word Identification Test. Maternal educational level was assessed by determining the last grade that had been completed by the mother.

Main Outcome Measure: The cognitive home environment (provision of learning materials, verbal responsiveness, teaching, and shared reading) was assessed using StimQ, an office-based interview measure.

Results: In unadjusted analyses, a maternal literacy level of ninth grade or higher was associated with increases in scores for the overall StimQ and each of 4 subscales, whereas a maternal educational level of ninth grade or higher was associated with increases in scores for the overall StimQ and 3 of 4 subscales. In simultaneous multiple linear regression models including both literacy and educational levels, literacy continued to be associated with scores for the overall StimQ (3.7; 95% confidence interval, 1.7-5.7) and all subscales except teaching, whereas maternal educational level was no longer significantly associated with scores for the StimQ (1.8; 0.5-4.0) or any of its subscales.

Conclusions: Literacy level may be a more specific indicator of risk than educational level in low-income families. Studies of low-income families should include direct measures of literacy. Pediatricians should develop strategies to identify mothers with low literacy levels and promote parenting behaviors to foster cognitive development in these at-risk families.

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Institutional Review Board and the Bellevue Research Committee for the study of the degree to which literacy accounts for the cognitive home environment and child developmental outcomes above and beyond low educational level in low-income households.

In this study, we therefore sought to determine the degree to which maternal literacy level accounts for associations between educational level and the cognitive home environment in low-income households. We hypothesized that, although educational level would be found to be related to the cognitive home environment, this relationship would be attenuated after accounting for literacy level, thus supporting literacy as a strong predictor of parenting behaviors targeting cognitive development. This information will be useful in creating future interventions to foster development within the home environment.

### METHODS

#### STUDY SAMPLE

This was an analysis of mother-infant dyads enrolled from November 1, 2005, through November 30, 2006, in a longitudinal study of early child development, the Bellevue Project for Early Language, Literacy, and Education Success (BELLE Project). The BELLE Project is a randomized, long-term study assessing the role of pediatric primary care-based interventions in promoting early child development among low-income families. Consecutive enrollment of eligible dyads occurred in the postpartum unit of Bellevue Hospital Center, an urban public hospital serving at-risk families. Inclusion criteria were intention to receive pediatric primary care at our institution for at least 3 years, English or Spanish as the primary language, an uncomplicated full-term delivery, no early intervention eligibility, mother as the primary caregiver, ability to contact the mother, mother’s age at least 18 years, and no significant maternal medical problems. This study was approved by the New York University School of Medicine Institutional Review Board and the Bellevue Research Committee. Written, informed consent was obtained from each mother at enrollment.

#### PROCEDURE

Mothers were assessed during 2 different time periods. The first assessment (baseline) occurred during mothers’ postpartum hospital stays. The second assessment occurred when infants reached age 6 months. Assessments were performed by bilingual research staff trained by one of us (S.B.B.), and reliability was maintained through periodic supervision.

### DEPENDENT VARIABLE

#### Cognitive Home Environment

The cognitive home environment was assessed using StimQ, a questionnaire designed for use in research and clinical settings that is based on a structured interview with the child’s caregiver. StimQ is validated for use in low-income populations and does not require a home visit. It has good internal consistency (Cronbach’s α = .88), test-retest reliability (intraclass correlation coefficient, 0.93), and criterion-related validity (correlation with HOME [Home Observation for Measurement of the Environment] score, r = 0.55; P < .001), and is gender neutral. It also has good concurrent validity with developmental measures and is correlated with the Bayley Scales of Mental Development Mental Development Index (semi-partial correlation is 0.45; P < .001). StimQ has been used in several recent studies of early child development performed with urban, economically disadvantaged populations.

StimQ-I (Infant) comprises 4 subscales:

1. Availability of Learning Materials assesses provision of developmentally appropriate toys (eg, rattles, toy instruments, or dolls with a human face) (score range, 0-6).
2. READ assesses shared reading activities. Items assess frequency of reading activities, number of books in the home, and diversity of content of books shared with the child (score range, 0-19).
3. Parental Involvement in Developmental Advance assesses the frequency and quality of teaching activities parents engage in with their children, such as pointing out and naming objects around the house or in supermarkets (score range, 0-7).
4. Parental Verbal Responsivity assesses verbal interactions between parents and their children, such as whether they play peekaboo or sing lullabies (score range, 0-11).

### INDEPENDENT VARIABLES

#### Literacy Level

Maternal literacy was assessed when the infant was aged 6 months using the Woodcock-Johnson III/Bateria III Woodcock-Munoz Tests of Achievement, Letter-Word Identification Test, which is standardized in English and Spanish and was administered in the mother’s preferred language. The Letter-Word Identification Test measures word reading skills and is highly correlated (r = 0.88) with an overall reading-writing factor on the Woodcock-Johnson III/Bateria III test; it is also one component of the Woodcock-Johnson III/Bateria III Basic and Broad Reading Skills Clusters, which are highly correlated (r = 0.68) with reading comprehension as measured by the Wechsler Individual Achievement Test. Grade equivalent scores were calculated and dichotomized as reading at high school level (≥ ninth grade) or lower, which is consistent with cutoff points used on other literacy measures such as the REALM (Rapid Estimate of Adult Literacy in Medicine) and corresponds approximately to the level of education associated with the transition from below basic to basic literacy skills as measured in the National Adult Literacy Survey.

#### Educational Level

Educational level was assessed at baseline by interview. We determined the last grade that had been completed by the mother. As with literacy level, educational level was dichotomized as ninth grade or higher compared with less than ninth grade.

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late prenatal care. In our analyses, mothers were considered at risk for involvement with child protective services, and having limited or unstable housing, being a victim of violence, having in-adequate health insurance, being unemployed, and having a history of drug or alcohol use. Maternal social risk factors were also assessed, including homelessness, being a victim of violence, having in-adequate health insurance, being unemployed, and having a history of drug or alcohol use. We assessed maternal depressive symptoms using the Patient Health Questionnaire 9. We used a cutoff score of 5 to define the presence of symptoms, corresponding to “mild depression.” Maternal social risk factors were also assessed, including homelessness, being a victim of violence, having in-adequate housing, being a victim of violence, having in-adequate health insurance, being unemployed, and having a history of drug or alcohol use.

RESULTS

STUDY SAMPLE

From November 1, 2005, through November 30, 2006, 369 mother-newborn dyads were identified as eligible, of whom 278 (75.3%) were enrolled in the study. Those who elected not to enroll primarily cited time constraints or partner reluctance. A total of 210 (75.5%) of these families underwent assessment when the infants were a mean (SD) age of 6.7 (1.1) months.

DESCRIPTIVE DATA

Table 1 shows descriptive data for the sample. Most mothers were immigrants and of Latina ethnicity. Mean (SD) maternal educational grade level was 10.0 (3.3), and 31.9% did not complete ninth grade. Mothers who did and did not complete the 6-month assessment were similar for country of origin, ethnicity, and infant’s sex and birth order. However, mothers who completed the 6-month assessment were somewhat less likely to have completed ninth grade (P = 0.09) and somewhat less likely to be English speaking (P = 0.09). Regarding literacy, mean (SD) reading grade level was 12.0 (4.8), and 34.5% read below the ninth grade level. Educational and reading levels showed only small to moderate correlation (r = 0.37; P < 0.001); 24.1% of those who completed ninth grade did not read at a ninth grade level, and 43.9% of those who did not complete ninth grade read at a ninth grade level or higher.

LITERACY LEVEL, EDUCATIONAL LEVEL, AND PARENTING

As shown in Table 2, in unadjusted analyses, maternal literacy of ninth grade level or higher was associated with scores for overall StimQ and each of the 4 subscales, whereas a maternal educational level of ninth grade or higher was associated with scores for overall StimQ and 3 of 4 subscales. In multiple regression analyses including literacy and educational levels and all potential confounders, such as maternal language, country of origin, ethnicity, age, marital status, social risk factors, depressive symptoms, and infant’s sex, age, and birth order, literacy continued to be associated with scores for overall StimQ and all subscales except for Parental Involvement in Developmental Advance (ie, teaching), whereas maternal educational level was no longer significantly associated with scores for StimQ or any of its subscales. In the multiple regression analysis predicting overall StimQ score, literacy level accounted for 5.7% of the variance, whereas educational level accounted for 1.0% of the variance.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total No. of Participants</th>
<th>Mean (SD) or % of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age, y</td>
<td>210</td>
<td>27.4 (5.6)</td>
</tr>
<tr>
<td>Spanish language</td>
<td>210</td>
<td>73.9</td>
</tr>
<tr>
<td>Latina</td>
<td>210</td>
<td>89.5</td>
</tr>
<tr>
<td>Married/partner</td>
<td>210</td>
<td>79.0</td>
</tr>
<tr>
<td>Low income</td>
<td>210</td>
<td>88.1</td>
</tr>
<tr>
<td>Mother’s highest grade completed</td>
<td>210</td>
<td>10.0 (3.5)</td>
</tr>
<tr>
<td>Mother’s highest grade completed &lt; ninth grade</td>
<td>210</td>
<td>31.9</td>
</tr>
<tr>
<td>Presence of any social risk factorsa</td>
<td>210</td>
<td>21.0</td>
</tr>
<tr>
<td>Child’s age, mo</td>
<td>210</td>
<td>6.7 (1.1)</td>
</tr>
<tr>
<td>Female child</td>
<td>210</td>
<td>52.9</td>
</tr>
<tr>
<td>First-born child</td>
<td>210</td>
<td>41.0</td>
</tr>
<tr>
<td>Mother’s reading level, gradeb</td>
<td>209</td>
<td>12.0 (4.8)</td>
</tr>
<tr>
<td>Mother’s reading level &lt; ninth gradeb</td>
<td>206</td>
<td>34.3</td>
</tr>
<tr>
<td>StimQ score</td>
<td>Totalc</td>
<td>17.7 (6.8)</td>
</tr>
<tr>
<td>ALMd</td>
<td>210</td>
<td>2.5 (1.1)</td>
</tr>
<tr>
<td>PIDAe</td>
<td>209</td>
<td>2.7 (1.6)</td>
</tr>
<tr>
<td>PVRf</td>
<td>209</td>
<td>5.0 (2.4)</td>
</tr>
<tr>
<td>READg</td>
<td>210</td>
<td>7.6 (4.2)</td>
</tr>
</tbody>
</table>

a One or more of late prenatal care, history of homelessness, victim of violence, or contact with child protective services. bWoodcock-Johnson/Woodcock-Munoz literacy tests missing for 4 mothers. cRange of possible scores, 0 to 43. dAvailability of Learning Materials (score range, 0-6). eParental Involvement in Developmental Advance (score range, 0-7). fParental Verbal Responsivity (score range, 0-11). gShared reading (score range, 0-19).

We calculated scores for the overall StimQ (range, 0-43) and for each subscale.

POTENTIAL CONFOUNDERS

Potentially confounding sociodemographic variables were assessed, including infant’s age, sex, and birth order, socioeconomic status, country of origin, primary language (based on language chosen for literacy test), and maternal depression and social risks. Higher rates of depression in low-income households are related to differences in parent-child interactions. We assessed maternal depressive symptoms using the Patient Health Questionnaire 9. We used a cutoff score of 5 to define the presence of symptoms, corresponding to “mild depression.” Maternal social risk factors were also assessed, including homelessness, being a victim of violence, having involvement with child protective services, and having limited or late prenatal care. In our analyses, mothers were considered at increased social risk if they had 1 or more of these factors.

STATISTICAL ANALYSES

Unadjusted associations between independent (educational and literacy levels) and dependent (cognitive home environment) variables were analyzed using independent-sample t tests. Simultaneous multiple regression analyses including both educational and literacy levels were performed to assess independent associations between these variables and the cognitive home environment. In these regression analyses, we adjusted for all potential confounders, including child’s age, sex, and birth order and maternal age, primary language, country of origin, marital status, presence of social risk factors, and presence of depressive symptoms, as well as exposure to interventions within the larger study. Socioeconomic status was not included in multiple regression models because of its strong relationship to level of education. Based on these analyses, we calculated unadjusted and adjusted mean differences and associated 95% confidence intervals. Multiple regression analyses were also used to determine the degree to which literacy and educational levels each explained independent variance in the cognitive home environment.
We found that maternal literacy level was associated with a wide range of parenting behaviors important for child development, including provision of toys and learning materials, shared reading activities, teaching activities, and verbal responsivity in the home. As hypothesized, whereas educational level was associated with the cognitive home environment, these associations were attenuated and became nonsignificant after adjusting for literacy level. These findings suggest that literacy level may account for the well-established effect of educational level on parenting, which has important implications for research and clinical practice.

Researchers have historically focused on maternal educational level as one of the most important risk factors related to the cognitive home environment and child developmental outcomes. However, whereas educational level has been recognized as a marker for literacy level, it has also been recognized that education and literacy are not equivalent. Educational level, which is measured as years completed or degrees obtained, does not necessarily measure literacy level, which is a more specific measure of functional skills that are relevant to the "demands of everyday life." As seen in our sample, as well as others, literacy level is often seen to vary in individuals with the same educational attainment.

In finding that literacy level attenuates the impact of educational level, our results strongly suggest that researchers should measure literacy level in studies of the cognitive home environment and child development in at-risk, low-income populations.

Clinically, there has been a recent focus regarding literacy and health literacy as important factors related to health disparities among at-risk pediatric and adult populations. Using the National Adult Literacy Survey database, Sentell and Halpin found literacy to be a more powerful predictor of adult health status than education or race and suggested that interventions to improve literacy might be effective in reducing health disparities. Studies of parental health literacy have shown associations with child outcomes including infant mortality, asthma and diabetes, and health care access and utilization. The recent focus on literacy as an explanation for health disparities has led to the development of new preventive strategies. The American Academy of Pediatrics has sought to improve the effectiveness of anticipatory guidance by creating plain-language handouts more appropriate for all parents, including those with low literacy levels. Other studies have created pictograms to better explain medication regimens and have been successful in improving adherence. Pediatric programs to improve child emergent literacy, such as Reach Out and Read, have sought to work with mothers at varying literacy levels. Our results provide strong support for developing strategies that take low maternal literacy levels into account in providing health and developmental guidance, and for explicitly addressing some of the ways that low literacy levels may affect access to information or the cognitive home environment. It is also important to consider ways that low literacy level may limit a parent's ability to provide stimulation and to consider interventions, which directly identify and address the issue of maternal literacy as a risk factor.

Table 2. Maternal Literacy and Educational Levels and Associations With Cognitive Home Environment

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Reading Grade-Level Equivalent</th>
<th>Mean (SD)</th>
<th>Mean Difference (95% CI)</th>
<th>Adjusted Mean Difference (95% CI)</th>
<th>Variance Accounted for in the Dependent Variable, sr², b, e %</th>
<th>Highest Grade Completed</th>
<th>Mean StimQ Score</th>
<th>Mean Difference (95% CI)</th>
<th>Adjusted Mean Difference (95% CI)</th>
<th>Variance Accounted for in the Dependent Variable, sr², b, e %</th>
</tr>
</thead>
<tbody>
<tr>
<td>StimQ, Total</td>
<td>&lt; 9</td>
<td>15.3 (6.5)</td>
<td>3.7 (1.8 to 5.6)</td>
<td>3.7 (1.7 to 5.7)</td>
<td>5.7 &lt; 9</td>
<td>14.7 (7.6)</td>
<td>4.3 (2.4 to 6.2)</td>
<td>1.8 (0.5 to 4.0)</td>
<td>1.0</td>
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</tr>
<tr>
<td></td>
<td>≥ 9</td>
<td>19.0 (6.5)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td>19.0 (6.0)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
</tr>
<tr>
<td>ALM³</td>
<td>&lt; 9</td>
<td>2.2 (1.1)</td>
<td>0.4 (0.1 to 0.7)</td>
<td>0.4 (0.1 to 0.8)</td>
<td>2.7 &lt; 9</td>
<td>2.1 (1.2)</td>
<td>0.5 (0.2 to 0.8)</td>
<td>0.1 (0.2 to 0.5)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 9</td>
<td>2.6 (1.1)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td>2.6 (1.1)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
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</tr>
<tr>
<td>PVRh</td>
<td>&lt; 9</td>
<td>4.1 (2.3)</td>
<td>1.3 (0.7 to 2.0)</td>
<td>1.2 (0.5 to 1.9)</td>
<td>4.5 &lt; 9</td>
<td>3.9 (2.4)</td>
<td>1.5 (0.8 to 2.2)</td>
<td>0.6 (0.2 to 1.5)</td>
<td>1.1</td>
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<tr>
<td></td>
<td>≥ 9</td>
<td>5.4 (2.4)</td>
<td>1 [Reference]</td>
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<td>5.4 (2.3)</td>
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<td>1 [Reference]</td>
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</tr>
<tr>
<td>PIDA¹</td>
<td>&lt; 9</td>
<td>2.3 (1.5)</td>
<td>0.5 (0.1 to 1.0)</td>
<td>0.4 (0.04 to 0.9)</td>
<td>1.4</td>
<td>2.4 (1.6)</td>
<td>0.4 (0.1 to 0.8)</td>
<td>0.4 (0.1 to 0.9)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 9</td>
<td>2.9 (1.6)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td>2.8 (1.6)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>READf</td>
<td>&lt; 9</td>
<td>6.7 (4.2)</td>
<td>1.4 (0.2 to 2.6)</td>
<td>1.6 (0.4 to 2.9)</td>
<td>3.0</td>
<td>6.3 (4.5)</td>
<td>1.9 (0.7 to 3.1)</td>
<td>0.6 (0.8 to 2.0)</td>
<td>0.3</td>
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<tr>
<td></td>
<td>≥ 9</td>
<td>8.1 (4.1)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td>8.2 (3.8)</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: ALM, Availability of Learning Materials; CI, confidence interval; ellipses, not applicable; PIDA, Parental Involvement in Developmental Advance; PVR, Parental Verbal Responsivity; READ, shared reading; sr, semipartial correlation.

a Difference compares mothers with a ninth grade reading level or higher with mothers with a reading level lower than ninth grade.

b Each line is based on a single, simultaneous multiple regression model predicting the dependent variable and including reading level, educational level, and all potential confounders.

c Variance in dependent variable accounted for by reading level.

d Difference compares mothers with educational levels of ninth grade and higher with mothers with an educational level of lower than ninth grade.

e Variance in dependent variable accounted for by educational level.

f P = 2.4; P < .001.

g P = 2.5; P < .003.

h P = 2.6; P < .001.

i P = 2.4; P < .001.
There are a number of limitations to our results. The measure that we used to test mothers’ literacy was a measure of word reading, not comprehension. Future studies should include specific measures of additional literacy skills, such as those used in the National Assessment of Adult Literacy, which measured prose, document, and quantitative literacy. In addition, the overall variance in StimQ accounted for by maternal literacy was relatively small in magnitude. Further study of the relationship between literacy and developmental outcomes is needed to delineate the clinical significance of these findings; this work is presently in progress. Also, measurement of the cognitive home environment, the primary outcome variable, was collected via parent report; results therefore may have been affected by social desirability bias. In addition, whereas we hypothesized that both reading level and educational level would affect the cognitive home environment, it is possible that these are only markers of other parental attributes that were not directly measured in this study. Finally, most mothers were Spanish-speaking, and approximately half were born outside of the United States; many completed school in their country of origin. Because completion of ninth grade may have different implications depending on the country, these results may not be generalizable to other populations.

In conclusion, literacy may be a more specific indicator of risk than educational level in low-income families. Studies of low-income populations should therefore include direct measures of literacy level. Given the relationship between low literacy level and parenting behaviors known to be related to child outcomes, pediatricians should consider developing strategies to identify mothers with low literacy levels in order to support the cognitive home environments for children of low-literacy parents.

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REFERENCES


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