Letter to the Editor

Mathematics achievement scores and early psychosis in school-aged children

Dear Editors,

Although evidence suggests that the typical age of onset of psychosis is in late adolescence into the mid-twenties (Kessler et al., 2007), those with psychosis vulnerability can exhibit earlier symptoms at a sub-diagnostic level as well as premorbid characteristics including academic difficulties. Within the United States, standardized measures of math achievement are routinely given as part of annual academic assessments and can therefore serve as one potential tool for examining cognitive vulnerability in the premorbid period. Although studies have examined the relation between early symptoms and general academic achievement (Ang and Tan, 2004; Dickson et al., 2012), to date, no study has specifically examined the relationship between these symptoms and standardized math achievement. Given that working memory is integral for mathematics computations (Meyer et al., 2010) and that impairments in this domain have characterized psychosis risk and schizophrenia patients (Fusar-Poli et al., 2012; Lee and Park, 2005), this is a potentially important area of inquiry.

In the present investigation, a large sample of 486 school-aged children (M age = 10.99, SD = 2.49, 50% male) from the Colorado Learning Disabilities Research Center was assessed to determine if math disorder was associated with psychosis items endorsed by parents and/or teachers (see Table 1). Recruiting and testing procedures for this study are described in detail in previous papers (see Willcutt et al., 2005). All participants had complete full-scale IQ (FSIQ), reading and math achievement, and behavioral data (Child Behavioral Checklist, see below).

Math achievement was assessed by the math subtest of the Wide Range Achievement Test, Revised (WRAT-R; Jastak and Wilkinson, 1984; M = 97.20, SD = 17.66). Per current research-area standards (see Mazzocco, 2008), children with math scores below the 11th percentile were considered to be Math Learning Disabled (MLD). Based on these cutoffs, 88 of the children were classified as MLD, and 398 were classified as non-MLD. Psychosis symptoms were assessed using 4 items taken from the Child Behavioral Checklist (CBCL; Achenbach, 1991; Achenbach et al., 2005). The 4 items, chosen on the basis of high face validity, included: 1) hears sounds or voices that aren’t there (M = 0.01, SD = 0.09), 2) sees things that aren’t there (M = 0.01, SD = 0.10), 3) strange behaviors (M = 0.09, SD = 0.37), and 4) strange ideas (M = 0.05, SD = 0.22). With respect to categorical ratings, children were classified as “psychosis-positive” if any of the 4 aforementioned items were rated as “very true or often true” by both parent and teacher. The current sample yielded 15 psychosis-positive children (3.09%) out of the 486 total participants who had CBCL ratings. A continuous measure of overall symptom frequency was also calculated by summing the total scores of the 4 items (M = 0.16, SD = 0.52). As the items showed weak internal consistency (Cronbach’s α = .30), items were also evaluated independently in continuous analyses.

The demographic and control/target variable differences between MLD/non-MLD as well as psychosis-positive/non-positive groups are presented in Table 1. The odds ratio of being in the psychosis-positive group if one met criteria for MLD relative to one who was non-MLD was 3.16 (95% CI = 1.10–9.13, z = 2.13, p = .03). In other words, a child with MLD was 3.16 times more likely to have exhibited a psychosis symptom relative to a child who was non-MLD. From a continuous perspective, Spearman correlations indicated that low math achievement was linked with elevated symptoms for the entire sample (r = −.13, p ≤ .01) and the magnitude of the effect increased in the psychosis-positive group alone (r = −.22, p = .22; Note: the low power for the supplementary analysis may have contributed to this null result). The strange behaviors (r = −.13, p ≤ .01) and strange ideas (r = −.10, p ≤ .05) items were most strongly correlated with math achievement whereas the other two items were not significant.

Our results indicate that children who are low achieving in mathematics (i.e., MLD) exhibit a significantly greater likelihood of being rated positively for psychosis behaviors relative to children who are typically achieving in math, perhaps due to the working memory deficits that underlie both disorders. Given that children are routinely being screened for math achievement, this may be one means of examining premorbid functioning in a broader population. In a related point, continued development in this area may allow for teachers and parents to more easily identify children who may be good candidates for additional in-depth screening (e.g., screening for a prodromal syndrome). Future studies would benefit from the use of empirically validated psychosis screeners (e.g., Prodromal-Questionnaire, Loewy et al., 2012; Community Assessment for Psychotic Experiences, Stefanis et al., 2002) and larger sample sizes. In addition, it would also be beneficial to determine whether other common developmental disabilities that are frequently assessed for in school settings may also be tied to elevated risk for psychosis symptomatology.

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Contributors
Ms. Wu and Dr. Mittal prepared and analyzed the data, conceptualized the study, and drafted the manuscript. Dr. Willcutt attained funding and assisted with the manuscript. Dr. Pennington also assisted with the manuscript.

Conflict of interest
There are no conflicts of interest to report.

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Letter to the Editor

Table 1
Demographics of the MLD versus non-MLD and psychosis-positive versus non-positive participants.

<table>
<thead>
<tr>
<th></th>
<th>Math learning disabled (MLD)</th>
<th></th>
<th>Psychosis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MLD (n = 88)</td>
<td>Non-MLD (n = 398)</td>
<td>r²</td>
<td>df</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>Positive (n = 15)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-positive (n = 471)</td>
<td></td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>42%</td>
<td>50%</td>
<td>1.94</td>
<td>1</td>
</tr>
<tr>
<td>Age</td>
<td>11.27 (2.78)</td>
<td>10.93 (2.42)</td>
<td>-1.17</td>
<td>484</td>
</tr>
<tr>
<td>FSIQ</td>
<td>95.90 (12.59)</td>
<td>110.44 (12.16)</td>
<td>10.03***</td>
<td>484</td>
</tr>
<tr>
<td>WRAT math achievement</td>
<td>72.63 (8.62)</td>
<td>102.65 (14.15)</td>
<td>19.09***</td>
<td>484</td>
</tr>
<tr>
<td>PIAT-R reading achievement</td>
<td>90.13 (12.10)</td>
<td>106.51 (11.11)</td>
<td>12.32***</td>
<td>484</td>
</tr>
<tr>
<td>CBCL DSM-oriented ADHD subscale</td>
<td>5.63 (3.80)</td>
<td>3.12 (3.28)</td>
<td>-6.26***</td>
<td>484</td>
</tr>
<tr>
<td>CBCL hears sounds</td>
<td>0.02 (0.15)</td>
<td>0.01 (0.07)</td>
<td>-1.67</td>
<td>484</td>
</tr>
<tr>
<td>CBCL sees things</td>
<td>0.01 (0.11)</td>
<td>0.01 (0.10)</td>
<td>-0.11</td>
<td>484</td>
</tr>
<tr>
<td>CBCL strange behavior</td>
<td>0.20 (0.55)</td>
<td>0.07 (0.32)</td>
<td>-3.19**</td>
<td>484</td>
</tr>
<tr>
<td>CBCL strange ideas</td>
<td>0.11 (0.25)</td>
<td>0.03 (0.18)</td>
<td>-3.98**</td>
<td>484</td>
</tr>
<tr>
<td>CBCL 4 psychosis item total</td>
<td>0.35 (0.80)</td>
<td>0.11 (0.42)</td>
<td>-3.12**</td>
<td>484</td>
</tr>
</tbody>
</table>

Note: Analyses of covariance (ANCOVA) were used to control for FSIQ, reading achievement, and ADHD symptom severity when examining MLD and non-MLD group differences in psychosis symptom severity. Analyses indicated the MLD and non-MLD group differences were still significant after controlling for FSIQ, reading achievement, and ADHD symptom severity.

For gender, statistic is a χ² instead of r-test.

⁎ p < .05.
⁎⁎ p < .01.
⁎⁎⁎ p < .001.

References


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