Association of Timing of Onset of Maternal Mental Disorders With Completion of Primary Education in Offspring

Poor school performance and risk of not completing primary education have been observed in children born of mothers with severe psychiatric disorders (eg, schizophrenia) at the time of conception and of mothers with mental disorders with specific onset during pregnancy and postpartum. It is, however, unknown whether the specific timing of onset of maternal mental disorders is associated with completion of primary education in offspring.

Methods | We conducted a population-based cohort study from January 1, 1996, to December 31, 2014, using data from the Danish Civil Registration System, the Danish Central Psychiatric Research Register, and the Primary Education Register. A total of 684,248 children born and living in Denmark from January 1, 1986, to December 31, 1996, were included, with complete information from birth to graduation of primary education from the Danish Civil Registration System. Data analysis was performed from July 1, 2018, to October 6, 2018. All analysis were performed according to Danish laws on the General Data Protection Regulation. In Denmark, register-based studies do not require informed consent. Data were deidentified. The study was approved by the Danish Data Protection Agency.

Information on exposure of maternal mental disorders was classified using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision codes F00 to F99, obtained through the Danish Psychiatric Central Research Register. Timing of onset was defined as the first date to F99, obtained through the Danish Psychiatric Central Research Register and the Primary Education Register. The association of timing of onset of maternal mental disorders with school completion was observed after adjusting for maternal age at birth and maternal mental disorders in the child and father.

Discussion | In our study, maternal mental disorders were associated with completion of primary education in offspring. Timing of disease onset had different associations, and children born to mothers with disease onset before conception were the most vulnerable. This finding suggests that duration of maternal illness is associated with school completion in children, with longer duration having the strongest association. Not being able to adjust for the child’s IQ and severity of maternal illness as confounders were limitations of this study.

Timing of maternal mental disease onset has been shown to directly and indirectly affect the developing fetus and the

### Table 1. Characteristics of the Study Population According to Completion of Primary Education

<table>
<thead>
<tr>
<th>Onset of Maternal Mental Disordera</th>
<th>No. (%) of Children</th>
<th>Finished (n = 639,052)</th>
<th>Not Finished (n = 45,196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No psychiatric contact</td>
<td>38,603 (85.4)</td>
<td>589,734 (92.3)</td>
<td></td>
</tr>
<tr>
<td>Before pregnancy</td>
<td>1702 (3.8)</td>
<td>10,976 (1.7)</td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td>66 (0.2)</td>
<td>419 (0.1)</td>
<td></td>
</tr>
<tr>
<td>First year after birth</td>
<td>195 (0.4)</td>
<td>1514 (0.2)</td>
<td></td>
</tr>
<tr>
<td>1-16 y After birth</td>
<td>4630 (10.2)</td>
<td>36,409 (5.7)</td>
<td></td>
</tr>
</tbody>
</table>

* A total of 55,911 children (8.2%) had a mother with a mental disorder.

### Table 2. Completion of Primary Education According to Timing of Maternal Mental Disordera

<table>
<thead>
<tr>
<th>Timing of Maternal Mental Disorder</th>
<th>Odds Ratio (95% CI)</th>
<th>Model 1b</th>
<th>Model 2c</th>
</tr>
</thead>
<tbody>
<tr>
<td>No psychiatric contact</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Before pregnancy</td>
<td>2.45 (2.33-2.58)</td>
<td>1.95 (1.85-2.06)d</td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td>2.34 (1.80-3.05)</td>
<td>1.64 (1.25-2.17)</td>
<td></td>
</tr>
<tr>
<td>First year after birth</td>
<td>1.94 (1.66-2.25)</td>
<td>1.40 (1.19-1.64)de</td>
<td></td>
</tr>
<tr>
<td>1-16 y After birth</td>
<td>1.79 (1.73-1.85)</td>
<td>1.47 (1.42-1.52)de</td>
<td></td>
</tr>
</tbody>
</table>

* In Denmark, primary education (10 years) is the equivalent of primary and lower secondary school in the United Kingdom and elementary and middle school in North America.

b Adjusted for sex and mother’s age at birth.

c Adjusted for sex, mother’s age at birth, child’s psychiatric history, and father’s severe mental disorder.

d P < .001 (compared with mothers with no psychiatric contact).

e P < .001 (compared with children of mothers with a diagnosis of mental disorders before pregnancy).

Results | Of the 684,248 included children (51.3% male), 45,196 did not complete primary education before 18 years of age (Table 1). Overall, children of mothers with maternal mental disorders were more likely to not complete primary education compared with children of mothers with no recorded mental disorders. The association of timing of onset with school completion in offspring was strongest if mothers had any mental disorders before conception (adjusted odds ratio, 1.95; 95% CI, 1.85-2.06) (Table 2). The association was weaker but remained statistically significant if onset of maternal disorders was observed 1 to 16 years after birth of the child (adjusted odds ratio, 1.47; 95% CI, 1.42-1.52) (Table 2). The association of timing of onset of maternal mental disorders with school completion was observed after adjusting for maternal age at birth and mental disorders in the child and father.
child after delivery\(^2\); the consequences may be associated with school performance and the likelihood of completing primary education. Explanations for this are multiple and include intrauterine stress and exposure to medication.\(^6\) After birth, maternal mental disorders can negatively impair bonding and attachment to the parents during the first months and years postpartum.\(^2\) Furthermore, circumstances across developmental stages during childhood and adolescence (eg, level of stimulation and nurturance of the child, home environment, parental support, exposure to trauma, and adverse life events) may also be associated with the child's ability to complete primary education.

Our results suggest that children born to mothers with mental disorders are more likely not to complete primary education and that the timing of onset of the maternal mental disorders is associated with this finding.

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Critical revision of the manuscript for important intellectual content: Ingstrup, Laursen, Bergink, Ranning.

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Supervision: Ranning, Munk-Olsen.

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in pregnancy and variations according to prior psychiatric history. 

Association of Prenatal Cannabis Exposure With Psychosis Proneness Among Children in the Adolescent Brain Cognitive Development (ABCD) Study

Mirroring increases in the general population, the prevalence of past-month marijuana use among pregnant mothers in the United States increased by 75% between 2002 (2.85%) and 2016 (4.98%).\(^1\) Although cannabis use has been linked to psychosis, little is known about prenatal exposure.\(^2\)\(^,\)\(^3\) Unprecedented increases in marijuana use during pregnancy, along-side evidence that cannabis use is correlated with psychosis and that endocannabinoids play an important role in neurodevelopment, highlight the importance of evaluating potential long-term consequences of prenatal exposure.\(^4\)

Methods | We used data from the ongoing Adolescent Brain Cognitive Development (ABCD) study (data release 1.0; https://abcdstudy.org/) to test whether maternal report of cannabis use during pregnancy is associated with psychosis proneness (Prodromal Questionnaire–Brief Child Version total score) among 4361 children aged 8.9 to 11.0 years who were born between 2005 and 2008 and 3774 mothers through 3926 pregnancies (Table). All parents provided written informed consent, and all children provided assent to a research protocol approved by the institutional review board at each data collection site (https://abcdstudy.org/study-sites/). The Prodromal Questionnaire–Brief Child version is a 21-item self-report questionnaire designed for children that assesses psychoticlike experiences; total scores range from 0 to 21, with higher scores indicating more psychoticlike experiences.\(^3\) Because the sample contains twin and non-twin siblings as well as 21 research sites, linear mixed-effects models were used to nest data on these parameters using the lme4 package in R, version 3.5.0 (The R Foundation). Analyses examining the association between offspring psychosis proneness and prenatal marijuana exposure before (0/1) and after (0/1) maternal knowledge of pregnancy (entered into the regression simultaneously) were conducted using 3 statistical models: (1) no fixed-effect covariates (FECs); (2) potentially confounding FECs (ie, child-, mother-, and pregnancy-related variables; eg, maternal alcohol and tobacco use during pregnancy), maternal education, household income, familial history of psychosis, unplanned pregnancy, child substance exposure; see footnote to the Table); and (3) only FECs significantly associated with psychosis proneness (Table),