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The presence of ADHD: Spillovers between siblings

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HIGHLIGHTS

- This paper studies potential spillover effects from having a sibling with ADHD.
- This paper employs OLS and cousin fixed effects using Danish register-data.
- Children are negatively affected by the presence of younger siblings with ADHD.
- The results are robust across specifications.

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ABSTRACT

This paper uses high quality register-data to study the spillover effects on firstborns from having a younger sibling suffering from ADHD. Using OLS and cousin fixed effects analyses it is found that the educational outcomes of healthy firstborn children are significantly reduced by the presence of a disordered sibling.

1. Introduction

It is well established that the developmental disorder Attention-Deficit/Hyperactivity-Disorder (ADHD) is strongly associated with worse performance in terms of a range of important human capital outcomes such as test scores and educational attainment (Currie and Stabile, 2006; Fletcher and Wolfe, 2008). This paper studies potential spillover effects from having a sibling with ADHD. More generally, the paper gives information about externalities associated with disabilities. Such analyses are of great importance when wanting to fully understand the societal implications of disabilities and of ADHD in particular.

To the best of my knowledge, only very little evidence exists on this type of question. An earlier paper by Fletcher and Wolfe (2008) finds that the detrimental effects of ADHD on child outcomes disappear when family fixed effects are included. This suggests that not only the child but also siblings are negatively affected. Fletcher et al. (2012) directly studies spillover effects of a sibling's poor health, broadly defined. Their findings suggest substantial negative associations between having a sibling with poor health and own educational outcomes.

When analyzing spillover effects we ideally want to compare the outcomes of two observationally equivalent healthy children, where one has a healthy sibling and the other has an unhealthy sibling. Since ADHD is highly heritable (Biederman et al., 1995; Safer, 1973), the strategy must be carefully chosen to make sure that the results are not affected by the child's own disorder, disorders of the parents, or a combination of the above. This paper's main contribution to the small existing literature is a solution to these core problems: given rich, register-based data it is possible to select a sample of firstborn children who do not themselves suffer from psychiatric diseases. This strategy ensures that the sample is homogeneous in terms of birth order[1] and eliminates the

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[1] As shown in Black et al. (2005) birth order may have large effects on human capital accumulation.

Table 1
Spillover effects from the presence of a sibling with ADHD.

Outcome	Sample mean	I	II	III	IV	V
Overall marks in 9th grade	0.188	−0.270***	−0.281***	−0.126***	−0.125***	−0.122***
		(0.018)	(0.018)	(0.016)	(0.016)	(0.013)
Reading—exit exam	0.133	−0.218***	−0.234***	−0.097***	−0.101***	−0.096***
		(0.023)	(0.023)	(0.022)	(0.022)	(0.018)
Math—exit exam	0.219	−0.307***	−0.307***	−0.142***	−0.138***	−0.134***
		(0.022)	(0.022)	(0.021)	(0.021)	(0.017)
Child characteristics			X	X	X	X
Parental characteristics				X	X	X
Region indicator					X	X
Birth cohort indicator					X	X
ADHD definition:						
Diagnosis	X	X	X	X		
Diagnosis or redeemed ADHD medication						X

Sample of firstborn children without any psychiatric diagnoses. 1795 with an ADHD diagnosed sibling, 160,581 without. In column V there are 2654 with an ADHD defined sibling and 160,581 without. Robust standard errors in parentheses. Individual level characteristics are described in Table A.1 in the Appendix.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

risk of sample skewness that may arise if parent's fertility choice is affected by the health of their child. An additional advantage is access to a rich set of relevant background characteristics all measured before or at the time of birth. Finally, ADHD is identified, not through self reported measures or through caregivers' answers, but through actual diagnoses.[2] Hence the spillover effects on healthy children can be credibly disentangled. I investigate the extent to which the lack of restrictions in the existing literature impacts the estimated effects of sibling ADHD.

2. Data and methods

My primary data source is the Danish Psychiatric Central Register. This data includes full psychiatric history of both parents and children diagnosed at a Danish general hospital before 2010.[3] Using unique personal identifiers data is augmented with a rich set of background variables. The personal identifiers further enable the linkage of generations: children can be linked to their parents and thus siblings, grandparents and hence cousins.

A child is defined as suffering from ADHD if he/she receives a diagnosis within the category Hyperkinetic Disorders (ICD-10 classification scheme) at a general hospital.[4] Children diagnosed at private clinics are not registered yet information from the Danish Prescription Drug database can be exploited. As a robustness check ADHD is redefined to include both diagnosed children and children without a diagnosis who have redeemed ADHD medication corresponding to at least six months of treatment in a given year.[5] For a discussion of the undiagnosed cases in Denmark see Kvist et al. (2013).

The goal is to estimate how a firstborn child's human capital accumulation, here captured by educational outcomes, is affected by the presence of a younger sibling with ADHD. The following outcome equation is considered:

$$Y_i = X_i'\beta_1 + \beta_2 ADHD_i^{sib} + \varepsilon_i, \quad (1)$$

where Y_i represents standardized educational outcomes as grade point average in the 9th grade,[6] reading and math scores at the 9th grade exit exam. $ADHD_i^{sib}$ is an indicator for the presence of a younger sibling with ADHD. X includes child and parental characteristics predictive of human capital development and ADHD all measured before or at the time of birth. For children this includes gender, gestational age, birth weight and APGAR[7] score. For both parents I have age at child birth, education, labor market participation, income, marital status, relationship stability, immigrant status, psychiatric diagnosis and maternal smoking behavior during pregnancy. Table A.1 in the Appendix shows mean background characteristics of firstborn children with and without an ADHD diagnosed sibling.

Despite the carefully selected sample and the rich set of relevant controls the parameter of interest may not be perfectly identified from this equation by OLS. Unobserved factors such as parental skills, child-rearing talents, or heritable endowments could affect human capital of the child and be associated with having a sibling with ADHD. By including cousin fixed effects this source of bias can be reduced to the extent that the unobservables are shared and transmitted similarly by cousins' parents.

To underline the importance of restricting to firstborns without ADHD, two other specifications are considered. Adding an indicator for own ADHD to Eq. (1) the child is allowed to have an ADHD diagnosis or other psychiatric diagnosis. This model is then estimated for a sample of firstborns with younger siblings and a sample of all children with siblings, controlling for birth order and family size.

3. Results

Table 1 shows the main OLS results. These suggest that the presence of a younger sibling with ADHD has a large statistically significant negative influence on a firstborn child's educational outcomes. Including child characteristics does not affect the estimates much. Since these are predictive of ADHD (e.g. Linnet et al., 2006) this substantially increases the likelihood that the results are not simply reflecting own undiagnosed ADHD.[8] The

[2] This implies a very robust definition since ADHD diagnosis in Denmark can only be given by a psychiatrist or a specialist physician but both parent, teachers and schools can decide to seek out a diagnosis (Dalsgaard et al., 2012a).

[3] For a detailed description see Munk-Jørgensen and Mortensen (1997).

[4] For a more detailed description of the decision stages and agents involved in diagnosing ADHD in Denmark see Dalsgaard et al. (2012b).

[5] This could either be Amphetamine (N06BA01), Methylphenidate (N06BA04) or Atomoxetine (N06BA09).

[6] In Denmark the 9th grade is generally passed at the age of 15. This may however depend on school starting age and grade repetition.

[7] The APGAR score assesses the health of newborn children immediately after birth. The score can range between 1 and 10, depending on appearance, pulse, grimace, activity, respiration, with 10 being the best score.

[8] This is also in line with the means comparison in Table A.1.