

Original Investigation

Associations of Parental Depression With Child School Performance at Age 16 Years in Sweden

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IMPORTANCE Depression is a common cause of morbidity and disability worldwide. Parental depression is associated with early-life child neurodevelopmental, behavioral, emotional, mental, and social problems. More studies are needed to explore the link between parental depression and long-term child outcomes.

OBJECTIVE To examine the associations of parental depression with child school performance at the end of compulsory education (approximately age 16 years).

DESIGN, SETTING, AND PARTICIPANTS Parental depression diagnoses (based on the *International Classification of Diseases, Eighth Revision [ICD-8]*, *International Classification of Diseases, Ninth Revision [ICD-9]*, and the *International Statistical Classification of Diseases, 10th Revision [ICD-10]*) in inpatient records from 1969 onward, outpatient records beginning in 2001, and school grades at the end of compulsory education were collected for all children born from 1984 to 1994 in Sweden. The final analytic sample size was 1 124 162 biological children. We examined the associations of parental depression during different periods (before birth, after birth, and during child ages 1-5, 6-10, and 11-16 years, as well as any time before the child's final year of compulsory schooling) with the final school grades. Linear regression models adjusted for various child and parent characteristics. The dates of the analysis were January to November 2015.

MAIN OUTCOME AND MEASURE Decile of school grades at the end of compulsory education (range, 1-10, with 1 being the lowest and 10 being the highest).

RESULTS The study cohort comprised 1 124 162 children, of whom 48.9% were female. Maternal depression and paternal depression at any time before the final compulsory school year were associated with worse school performance. After covariate adjustment, these associations decreased to -0.45 (95% CI, -0.48 to -0.42) and -0.40 (-0.43 to -0.37) lower deciles, respectively. These effect sizes are similarly as large as the observed difference in school performance between the lowest and highest quintiles of family income but approximately one-third of the observed difference between maternal education of 9 or less vs more than 12 years. Both maternal depression and paternal depression at different periods (before birth, after birth, and during child ages 1-5, 6-10, and 11-16 years) generally were associated with worse school performance. Child sex modified the associations of maternal depression with school performance such that maternal depression had a larger negative influence on child school performance for girls compared with boys.

CONCLUSIONS AND RELEVANCE Diagnoses of parental depression throughout a child's life were associated with worse school performance at age 16 years. Our results suggest that diagnoses of parental depression may have a far-reaching effect on an important aspect of child development, with implications for future life course outcomes.

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Depression is a leading cause of morbidity and disability worldwide,¹ with adverse consequences not just for affected persons but also for family members, especially children. The results of studies²⁻⁷ have suggested the associations of parental depression with child neurodevelopmental, behavioral, emotional, and psychiatric problems.

While parental depression has been linked with child outcomes, the findings of only a few studies have suggested an association between parental depression and poorer school performance.⁸⁻¹³ For example, the results of a cross-sectional study⁸ of 248 children aged 4 to 6 years suggested that children with depressed fathers were 9 times more likely to have language development problems than those children without depressed fathers. A study¹¹ of 132 women in south London, England, found that children of mothers with postnatal depression had lower IQ scores at age 11 years, as well as lower mathematical reasoning and greater special educational needs. However, questions remain as to whether parental depression has an important effect on school performance or whether such associations are due to confounding because few investigations have the sample size and available covariates to robustly examine this issue. Notably, Evans et al¹² examined more than 5000 mother-child pairs in a United Kingdom birth cohort and found no association of maternal postnatal depression with child IQ at age 8 years. They also observed that an apparent effect of prenatal depression on child IQ (approximately a 3-point reduction) disappeared after covariate adjustment for maternal health and sociodemographic characteristics.

Poor school performance is a powerful predictor of future health outcomes, including poorer self-rated health, underweight or overweight status, binge drinking, psychiatric morbidity, and even suicide.¹⁴⁻¹⁸ Moreover, by its influence on educational attainment and subsequent occupation and income, school performance affects adult social position, one of the strongest predictors of future health and mortality.^{19,20} The mechanisms of how parental depression could affect child school performance are likely complex and interrelated. First, because depression is heritable,²¹ parental depression may genetically predispose children to depression and other mental health problems, which can lead to poorer school performance.^{22,23} Second, parental depression might influence neurodevelopment during the prenatal and postnatal periods. In the prenatal period, maternal depression may influence neurodevelopment via neuroendocrine or inflammatory pathways.^{24,25} In the postnatal period, parental depression is associated with suboptimal breastfeeding and sleep practice, as well as less warmth, responsiveness, and cognitive support from parents,²⁶⁻²⁸ which can influence attachment to the caregiver, cognitive ability, mental health, and language development.^{3,9-11,29-32} Third, parental depression may affect children via social pathways by contributing to parent-child and interparental conflict,^{33,34} which can lead to internalizing or externalizing problems.³⁵ Behavioral problems are in turn robustly associated with poorer academic performance.^{28,36-38} Therefore, child school performance is a highly relevant outcome to appraise for the effect of parental depression. In the present study, we examined the associations of maternal and paternal depression with child school performance at age 16 years in a Swedish sample of more than 1 million individuals.

Methods

Study Population

This investigation was a nationwide cohort study of children born in Sweden from 1984 to 1994 (n = 1 196 929). Exclusion criteria were adopted children, children who could not be linked to their biological mother or father, and children without data on school grades at the end of compulsory education (because of death, emigration, lack of completion, intellectual disability, or administrative error). In the analysis, children missing data on key covariates were excluded. The final analytic sample consisted of 1 124 162 individuals (93.9% of the persons born in Sweden during this period) (eFigure in the Supplement). Characteristics of excluded individuals are listed in eTable 1 in the Supplement. In this national sample, depression diagnoses are based on data from national registers primarily covering inpatient admissions.

We conducted a subsample analysis in children who had ever resided in Stockholm County, Sweden, during the study period.³⁹ The subsample analysis examined whether a broader definition of parental depression influenced the results. In this subsample, ascertainment of depression is based on both the national register data and regional register data from outpatient, specialist, and treatment centers in Stockholm County.⁴⁰ This Stockholm County subsample consisted of 214 668 individuals (19.1% of the national sample). This study was approved by the institutional review board at Drexel University (Philadelphia, Pennsylvania) and by the research ethics committee at Karolinska Institutet (Stockholm, Sweden). Following Swedish regulation, the use of register data for research purposes does not require informed consent. The dates of the analysis were January to November 2015.

School Performance

Data on school grades were collected from the national school register.^{41,42} Compulsory education in Sweden lasts until age 16 years on average. On completion of compulsory schooling, students are assigned a final school grade calculated as the sum of the 16 best subject grades in the final year. For every subject, students are assigned a grade ranging from 0 to 20, in which 0 is failing, 10 is E, 12.5 is D, 15 is C, 17.5 is B, and 20 is A. Therefore, the final school grade can range from 0 to 320. Because the distribution of the final grade was skewed, as well as to increase interpretability, decile of performance (range, 1-10, with 1 being the lowest and 10 being the highest) was used as the outcome of interest.

Parental History of Depression

For the national sample, depression diagnoses were collected from the national patient register, which recorded inpatient contacts (since 1969) and outpatient contacts (since 2001), with follow-up through 2011. We identified parental depression as any registered diagnosis of a depressive episode or mood disorder. Using the Nordic versions, *International Classification of Diseases, Eighth Revision (ICD-8)* code 300.4 was used for depression diagnoses between 1969 and 1986; *International Classification of Diseases, Ninth Revision (ICD-9)* codes

300.4, 296.2, 296.3, and 311 were used from 1987 to 1996; and *International Statistical Classification of Diseases, 10th Revision (ICD-10)* codes F32 through F39 were used since 1997. The national patient register has moderately high validity for various psychiatric conditions, including bipolar disorder and schizophrenia.^{43,44} A validation study⁴⁵ of more than 3000 individuals compared register diagnoses of depression with a criterion standard of clinical diagnoses from court-ordered inpatient evaluations and found 88% agreement.

For the Stockholm County subsample, we identified parental depression as any diagnoses in the national patient register or in the Stockholm County adult psychiatric outpatient register, which records any contact with specialist outpatient psychiatric services in Stockholm County since 1997. We used *DSM-IV* codes 317 to 319 until 2008 and *ICD-10* until 2009, consistent with prior studies.^{39,46}

To ensure proper temporal ordering, only parental depression diagnoses occurring before the start of the child's final compulsory year were considered. Initially, we examined whether any history of parental depression before the start of the child's final year was associated with school performance. We then examined whether depression diagnoses during specific periods were associated with school performance, including any history of depression before the birth of the child, after birth (child ages 0 to <1 year), and during child ages 1 to 5 years, 6 to 10 years, and 11 to 16 years.

Other Characteristics

Covariates of interest, identified in the literature or in preliminary analyses as associated with school performance,^{37,41,47} were collected from the registers. Child characteristics include sex, birth year, birth order, and whether the child was part of a multiple birth. Pregnancy characteristics include maternal age (<20, 20-24, 25-29, 30-34, 35-39, 40-44, or ≥45 years) and paternal age (<20, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, or ≥50 years) at the birth of the child, and maternal smoking during pregnancy (yes, no, or missing) was assessed via midwife interview at the first prenatal visit.⁴⁸ Family characteristics include parental education (≤9, 10-12, or ≥13 years), quintile of disposable family income adjusted for year and family size, parental region of birth (Sweden, other Nordic countries, or outside of Nordic countries), and parental alcohol abuse before the birth of the child (*ICD-8* codes 291 and 303; *ICD-9* codes 291, 303, and 305.0; and *ICD-10* code F10).

Statistical Analysis

Analyses were conducted using statistical software (R, version 3.1.3; R Foundation). In descriptive analyses, we calculated the mean decile of school grades among different subgroups, with 95% CIs calculated using bootstrap resampling. Generalized linear mixed models were used to assess the associations of parental depression and school performance. A random intercept was specified for the mother, and all other variables were considered as fixed effects. In addition to maternal and paternal depression, model 1 included child characteristics (sex, multiple births, and birth year). Model 2 included model 1 covariates and pregnancy characteristics (maternal age at birth, birth order, and maternal smoking dur-

ing pregnancy). Model 3 included model 2 covariates and family characteristics (paternal age, parental education, parental alcohol abuse before the birth of the child, family income, and parental region of birth).

We examined depression in the following time windows: any history of depression before the birth of the child, the postnatal period, and during child ages 1 to 5, 6 to 10, and 11 to 16 years. We first examined parental depression before birth in model 3a and subsequently added later depression diagnoses in models 3b through 3e. By examining how the associations change with the addition of subsequent depression diagnoses, we can gain insight about potential independent mechanisms linking parental depression and school performance. To explore effect modification by child sex, stratified models were also analyzed.

Results

Table 1 lists school grades in relation to study sample characteristics. Girls had better grades than boys, while younger maternal and paternal age was associated with poorer school performance. Maternal smoking during pregnancy was associated with worse school performance. Higher family income, parental education, and parental origin from Sweden were associated with better school performance.

In the national sample, 33 906 mothers (3.0%) and 23 724 fathers (2.1%) had depression before the final year of child compulsory education. Of parents with depression, 50.6% were identified via inpatient records, with the remainder identified through outpatient records. In the Stockholm County subsample, 16 138 mothers (7.5%) and 8837 fathers (4.1%) had depression diagnoses recorded before the final year. Most (85.9%) of the subsample parents with depression were identified from outpatient records.

Parental Depression and School Performance

Both crude and adjusted models indicated that parental depression was associated with worse academic performance (**Table 2**), although the associations decreased after covariate adjustment. In unadjusted analysis of the national sample, maternal history and paternal history of depression at any time before the final year of compulsory schooling were associated with -0.80 (95% CI, -0.83 to -0.77) and -0.73 (95% CI, -0.77 to -0.69) lower deciles of school grades, respectively. After covariate adjustment (model 3), the associations of maternal depression and paternal depression with school performance decreased to -0.45 (95% CI, -0.48 to -0.42) and -0.40 (95% CI, -0.43 to -0.37) lower deciles, respectively.

Analysis of the Stockholm County subsample, with most depression cases identified from outpatient care, showed adverse associations with school performance on the same order of magnitude. While estimates of maternal depression associations in the subsample were virtually identical to those of the national sample, the paternal depression estimate was approximately 33% smaller (**Table 2**). The Stockholm County subsample differs from the national sample in many respects, with older and better educated parents, more first-born children, more parents born outside of Sweden, and more families in the highest quintile of income (eTable 2 in the

Table 1. Characteristics and School Performance at the End of Compulsory Education Among 1 124 162 Children Born From 1984 to 1994 in Sweden

Covariate	No. (%)	Mean Difference (95% CI) in Decile of School Performance ^a
Child sex		
Male	574 194 (51.1)	1 [Reference]
Female	549 968 (48.9)	1.14 (1.13 to 1.15)
Multiple birth		
No	1 098 796 (97.7)	1 [Reference]
Yes	25 366 (2.3)	0.20 (0.17 to 0.23)
Maternal age, y		
<20	28 947 (2.6)	-1.81 (-1.84 to -1.78)
20-24	254 211 (22.6)	-0.79 (-0.81 to -0.78)
25-29	420 427 (37.4)	1 [Reference]
30-34	287 409 (25.6)	0.35 (0.33 to 0.36)
35-39	112 367 (10.0)	0.42 (0.40 to 0.44)
40-44	20 159 (1.8)	0.31 (0.27 to 0.35)
≥45	642 (0.1)	0.22 (-0.04 to 0.45)
Birth order		
1	458 173 (40.8)	1 [Reference]
2	402 458 (35.8)	-0.30 (-0.31 to -0.29)
3	185 621 (16.5)	-0.57 (-0.59 to -0.56)
≥4	77 910 (6.9)	-1.12 (-1.14 to -1.10)
Maternal smoking during pregnancy		
No	791 157 (70.4)	1 [Reference]
Yes	262 544 (23.4)	-1.47 (-1.48 to -1.46)
Missing	70 461 (6.3)	-0.56 (-0.58 to -0.54)
Paternal age, y		
<20	6977 (0.6)	-1.80 (-1.85 to -1.74)
20-24	130 567 (11.6)	-0.82 (-0.84 to -0.80)
25-29	354 873 (31.6)	1 [Reference]
30-34	344 245 (30.6)	0.40 (0.39 to 0.41)
35-39	189 429 (16.9)	0.47 (0.45 to 0.49)
40-44	71 033 (6.3)	0.37 (0.34 to 0.39)
45-49	19 740 (1.8)	0.27 (0.23 to 0.32)
≥50	7298 (0.6)	0.18 (0.11 to 0.25)
Maternal region of birth		
Sweden	992 803 (88.3)	1 [Reference]
Other Nordic countries	43 507 (3.9)	-0.44 (-0.46 to -0.41)
Outside of Nordic countries	87 852 (7.8)	-0.21 (-0.23 to -0.19)
Paternal region of birth		
Sweden	985 748 (87.7)	1 [Reference]
Other Nordic countries	36 848 (3.3)	-0.76 (-0.79 to -0.73)
Outside of Nordic countries	101 566 (9.0)	-0.32 (-0.34 to -0.30)
Maternal education, y		
≤9	207 560 (18.5)	-1.21 (-1.23 to -1.20)
10-12	616 969 (54.9)	1 [Reference]
≥13	299 633 (26.7)	1.73 (1.72 to 1.74)

(continued)

Table 1. Characteristics and School Performance at the End of Compulsory Education Among 1 124 162 Children Born From 1984 to 1994 in Sweden (continued)

Covariate	No. (%)	Mean Difference (95% CI) in Decile of School Performance ^a
Paternal education, y		
≤9	251 933 (22.4)	-0.81 (-0.82 to -0.80)
10-12	582 316 (51.8)	1 [Reference]
≥13	289 913 (25.8)	1.76 (1.75 to 1.77)
Family income quintile		
1, Lowest	194 644 (17.3)	-0.46 (-0.47 to -0.44)
2	231 353 (20.6)	-0.31 (-0.33 to -0.30)
3	232 305 (20.7)	1 [Reference]
4	233 265 (20.8)	0.37 (0.36 to 0.39)
5, Highest	232 595 (20.7)	1.21 (1.19 to 1.22)
Maternal alcohol abuse before the birth of the child		
No	1 121 074 (99.7)	1 [Reference]
Yes	3088 (0.3)	-1.89 (-1.98 to -1.80)
Paternal alcohol abuse before the birth of the child		
No	1 113 747 (99.1)	1 [Reference]
Yes	10 415 (0.9)	-1.78 (-1.83 to -1.73)

^a Decile of school performance ranges from 1 (lowest) to 10 (highest). Estimates shown are the mean difference in decile of school performance between different category values. For example, on average, girls scored 1.14 deciles higher compared with boys (the reference group). The 95% CIs were calculated using bootstrap resampling with 1000 iterations.

Supplement). To maintain generalizability, we focus the rest of the analyses on the national sample.

The coefficients of parental depression and key covariates are compared in the Figure. For example, the magnitude of the association between maternal depression and child school performance (-0.45 deciles) was larger than that for low family income with child school performance (-0.36 deciles for quintile 1 vs quintile 5) but was smaller than that for low maternal education (-1.62 deciles for ≤9 vs ≥13 years).

Timing of Maternal and Paternal Depression

We investigated whether timing of parental depression diagnosis influenced child school performance. There was moderate recurrence of depression in the sample. Of depression cases identified during a particular period, 13.1% to 21.5% of parents with depression had previous diagnoses in earlier periods. For example, 6944 of the 32 824 parents (21.2%) diagnosed during child ages 11 to 16 years had a depression diagnosis in an earlier period.

In general, paternal depression and maternal depression in all periods were independently associated with worse school performance (Table 3, models 3a-e), although paternal depression during the postnatal period did not attain statistical significance at $P < .05$. Even after adjustment for parental depression in earlier periods, the associations in later periods remained, suggesting that parental depression in each period was independently associated with worse school performance.

Table 2. Associations of Parental Depression and Child School Performance at the End of Compulsory Education in Birth Cohorts Born From 1984 to 1994

Variable	Decile (95% CI) of School Performance			
	Crude	Mean Difference ^a		
		Model 1	Model 2	Model 3
Swedish population (n = 1 124 162)				
Maternal depression before child age 16 y (n = 33 906)	-0.80 (-0.83 to -0.77)	-0.81 (-0.84 to -0.78)	-0.61 (-0.64 to -0.58)	-0.45 (-0.48 to -0.42)
Paternal depression before child age 16 y (n = 23 724)	-0.73 (-0.77 to -0.69)	-0.72 (-0.76 to -0.69)	-0.61 (-0.64 to -0.57)	-0.40 (-0.43 to -0.37)
Stockholm County subsample (n = 214 668)				
Maternal depression before child age 16 y (n = 16 138)	-0.67 (-0.72 to -0.62)	-0.75 (-0.80 to -0.71)	-0.59 (-0.63 to -0.54)	-0.44 (-0.48 to -0.39)
Paternal depression before child age 16 y (n = 8837)	-0.47 (-0.53 to -0.40)	-0.49 (-0.55 to -0.43)	-0.44 (-0.50 to -0.38)	-0.27 (-0.32 to -0.21)

^a Estimates are derived from generalized linear mixed models with a random effect for birth mother and can be interpreted as the expected difference in decile of school performance (with 1 being the lowest and 10 being the highest) associated with any parental depression diagnosis before the academic start of the child's final compulsory education year conditional on covariates. Model 1 adjusted for child characteristics (sex, multiple births, and

birth year). Model 2 adjusted for model 1 and pregnancy characteristics (maternal age at birth, birth order, and maternal smoking at the first prenatal visit). Model 3 adjusted for model 2 and family characteristics (paternal age, parental education, parental alcohol abuse before the birth of the child, quintile of annual family income adjusted for year and family size, and parental region of birth).

Maternal vs Paternal Depression

In the national sample, maternal and paternal depression had similarly large associations with school performance overall (Table 2) and in most periods assessed (Table 3). In the Stockholm County subsample with a broader definition of depression, maternal depression had a larger effect than paternal depression overall (Table 2) and in many periods of interest (eTable 3 in the Supplement). For example, during the period of child ages 11 to 16 years, the association of maternal depression with school performance was 1.6 times larger (-0.41 decile) than that for paternal depression (-0.26 decile).

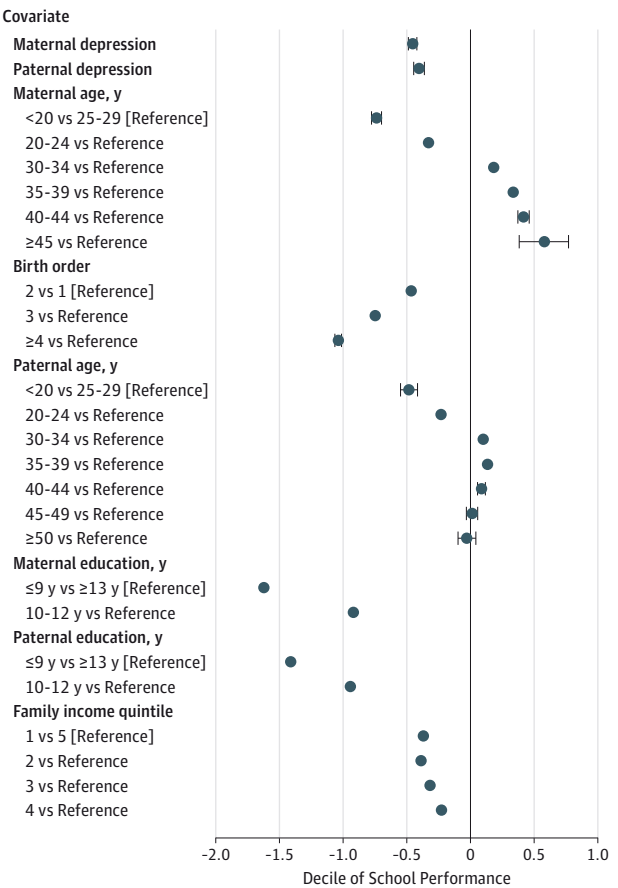
Boys vs Girls

There was evidence that the associations of maternal depression with child school performance were different for boys and girls, but the associations of paternal depression were similar for boys and girls (Table 4). Likelihood ratio testing of nested models showed that a model with interaction terms of sex and maternal depression had significantly better fit than the model without ($P < .001$), but interaction terms of sex and paternal depression did not improve the fit ($P = .16$). Analyses stratified by sex suggested that maternal depression episodes before birth and during child ages 6 to 10 and 11 to 16 years were more associated with school performance in girls than in boys. For example, maternal depression at child ages 11 to 16 years was associated with lower deciles of school performance of -0.51 in girls compared with -0.34 in boys.

Discussion

In this study of more than 1 million children from a nationwide cohort in Sweden, maternal depression and paternal depression were both independently associated with lower academic performance at child age 16 years. Adjustment for a wide range of covariates attenuated the associations, suggesting the presence of confounding, although evidence of a parental depression effect remained. Parental depression during multiple periods of child development was independently associated with worse school performance. Magnitudes of the associations appeared to be modest but of potential signifi-

Figure. Adjusted Associations of Selected Parent and Child Characteristics With Deciles of School Performance



Bars indicate 95% CIs.

cance. For example, the effect sizes of parental depression on school performance are similarly as large as the observed difference in school performance between the lowest and highest quintiles of family income. Finally, child sex modified the associations of maternal depression such that maternal de-

Table 3. Associations of Parental Depression at Different Periods and Child School Performance at the End of Compulsory Education Among 1 124 162 Children Born From 1984 to 1994 in Sweden

Variable	Mean Difference (95% CI) in Decile of School Performance ^a				
	Model 3a	Model 3b	Model 3c	Model 3d	Model 3e
Before birth					
Maternal depression (n = 6459)	-0.32 (-0.39 to -0.25) ^b	-0.31 (-0.38 to -0.25)	-0.30 (-0.37 to -0.23)	-0.28 (-0.34 to -0.21)	-0.25 (-0.32 to -0.18)
Paternal depression (n = 4787)	-0.35 (-0.43 to -0.28) ^b	-0.35 (-0.43 to -0.27)	-0.34 (-0.41 to -0.26)	-0.32 (-0.40 to -0.24)	-0.30 (-0.38 to -0.22)
After birth					
Maternal depression (n = 556)		-0.34 (-0.54 to -0.15) ^b	-0.32 (-0.51 to -0.12)	-0.29 (-0.49 to -0.10)	-0.25 (-0.45 to -0.05)
Paternal depression (n = 335)		-0.18 (-0.43 to 0.08) ^b	-0.11 (-0.36 to 0.15)	-0.09 (-0.34 to 0.17)	-0.07 (-0.33 to 0.18)
Child ages 1-5 y					
Maternal depression (n = 3415)			-0.30 (-0.38 to -0.21) ^b	-0.25 (-0.34 to -0.17)	-0.21 (-0.29 to -0.12)
Paternal depression (n = 2823)			-0.34 (-0.43 to -0.25) ^b	-0.31 (-0.40 to -0.22)	-0.28 (-0.37 to -0.19)
Child ages 6-10 y					
Maternal depression (n = 9758)				-0.38 (-0.43 to -0.33) ^b	-0.30 (-0.35 to -0.25)
Paternal depression (n = 6816)				-0.31 (-0.37 to -0.25) ^b	-0.25 (-0.31 to -0.19)
Child ages 11-16 y					
Maternal depression (n = 20 037)					-0.41 (-0.44 to -0.37) ^b
Paternal depression (n = 12 787)					-0.35 (-0.39 to -0.30) ^b

^a Models 3a through 3e are adjusted for all covariates from model 3 in Table 2.

^b P < .05.

Table 4. Associations of Parental Depression at Different Periods and Child School Performance at the End of Compulsory Education in the Swedish Population Born From 1984 to 1994, Stratified by Child Sex

Variable	Mean Difference (95% CI) in Decile of School Performance	
	Girls (n = 549 968)	Boys (n = 574 194)
Before birth^a		
Maternal depression	-0.39 (-0.49 to -0.30)	-0.24 (-0.33 to -0.15)
Paternal depression	-0.36 (-0.47 to -0.25)	-0.34 (-0.44 to -0.24)
After birth^b		
Maternal depression	-0.39 (-0.68 to -0.10)	-0.35 (-0.63 to -0.07)
Paternal depression	-0.23 (-0.61 to 0.14)	-0.13 (-0.48 to 0.22)
Child ages 1-5 y^c		
Maternal depression	-0.35 (-0.47 to -0.22)	-0.30 (-0.42 to -0.19)
Paternal depression	-0.41 (-0.54 to -0.27)	-0.28 (-0.41 to -0.16)
Child ages 6-10 y^d		
Maternal depression	-0.50 (-0.57 to -0.42)	-0.33 (-0.40 to -0.27)
Paternal depression	-0.32 (-0.40 to -0.23)	-0.37 (-0.45 to -0.29)
Child ages 11-16 y^e		
Maternal depression	-0.51 (-0.56 to -0.46)	-0.34 (-0.39 to -0.29)
Paternal depression	-0.39 (-0.46 to -0.33)	-0.35 (-0.41 to -0.29)

^a Models adjusted for all covariates from model 3a in Table 3.

^b Models adjusted for all covariates from model 3b in Table 3.

^c Models adjusted for all covariates from model 3c in Table 3.

^d Models adjusted for all covariates from model 3d in Table 3.

^e Models adjusted for all covariates from model 3e in Table 3.

pression had a larger negative influence on school performance for girls than for boys.

Our findings suggest that both longer-term and shorter-term pathways may link parental depression with child outcomes, consistent with prior studies.^{21,33,49-53} For example, even after adjusting for depression in later periods, parental depression before the birth of the child was associated with worse school performance. This finding supports the conten-

tion that a shared genetic liability may be an important link between parental depression and child adverse outcomes.^{21,52,53} Notably, parental depression in all periods after the birth of the child was associated with worse school performance, suggesting that social pathways also may be involved.

In comparing relative effects of maternal and paternal depression, analysis of the national sample (with half of the cases identified from inpatient care) suggested that maternal depression and paternal depression had similar associations with school performance. However, with depression assessed mostly from outpatient care in the subsample, maternal depression outweighed paternal depression in adverse effects. This finding suggests that less severe parental depression may be more detrimental to the child when it occurs in the mother than in the father, consistent with previous studies.⁵⁴⁻⁵⁶

Our study showed that, on average, maternal depression at child ages 6 to 10 and 11 to 16 years had a larger influence on child school performance for girls compared with boys. This finding is consistent with the results of prior studies⁵⁷⁻⁵⁹ that suggest that girls may be more sensitive to adverse effects of maternal depression. However, we did not find a similar difference of effect by sex for paternal depression. This finding suggests that parental depression effects on child school performance are not wholly due to genetic liability because effects should be similar for mothers and fathers regardless of child sex. One explanation is that relationships of mothers-daughters and fathers-daughters are different. The results of a previous study⁶⁰ suggested that perceived paternal availability for daughters decreased as the girl grew older but that perceived maternal availability remained constant for both boys and girls across all ages. Another explanation is that the burden of taking care of a mentally ill parent, especially the mother, may disproportionately affect girls.⁶¹

Our study had notable strengths. First, this study had a long follow-up and a large sample size. Second, the registers allowed for adjustment for many potential confounders and ob-

jective assessment of depression without recall bias in a universal health care system that minimizes disparities in access to care. This strength is an improvement over prior investigations that have only examined parental depression diagnoses during limited periods.

Several limitations must be noted. A substantial limitation is the underdiagnosis of depression because register diagnoses based on service use always underestimate the true extent of depression in the population that remains undiagnosed and untreated. However, it is reassuring that the subsample analysis (with better ascertainment) also showed similar adverse effects of parental depression on school performance. Although we adjusted for multiple covariates, the fact that the associations were attenuated after adjustment is a cautionary note that the results may be affected by residual confounding. In addition, we could not identify if children were living with the birth parents for the duration of the study. In Sweden, three-quarters of children aged 0 to 17 years have a registered address at the same address as both parents, and 80% of children living in single-parent households are registered with the mother.⁶² However, parents need not be living with the child in order for parental depression to affect a child. For example, if genetic mechanisms are at play, then the child does not need to be

exposed to household parental depression in order for parental depression to influence school performance. In the case of environmental mechanisms, frequent contact (despite living apart) could equally affect the child, or simply the knowledge that a parent has mental health issues may cause worry in a child. Finally, limitations of the data prevented further exploration of mechanistic hypotheses. There were too few depression diagnoses captured in our data during the pregnancy period to assess the effect of prenatal depression. Similarly, there was insufficient capture of child psychiatric disorders in the registers to allow for assessment of potential mediation by child psychiatric health.

Conclusions

Our results suggest that diagnoses of parental depression may have a far-reaching effect on child development. Because parental depression may be more amenable to improvement compared with other influences, such as socioeconomic status, it is worth verifying the present results in independent cohorts. If the associations observed are causal, the results strengthen the case even further for intervention and support among children of affected parents.

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