

# Parents' postnatal depressive symptoms and their children's academic attainment at 16 years: Pathways of risk transmission

Lamprini Psychogiou<sup>1</sup>, Ginny Russell<sup>2</sup>, and Matthew Owens<sup>1</sup>

<sup>1</sup>School of Psychology, University of Exeter, Exeter, UK

<sup>2</sup>Institute of Health Research, University of Exeter Medical School, Exeter, UK

**Correspondence:** Lamprini Psychogiou, University of Exeter, School of Psychology, Mood Disorders Centre, Washington Singer Laboratories, Perry Road, Exeter, EX4 4QG. Telephone: ++44 01392 725047; Email: L.Psychogiou@exeter.ac.uk

**Acknowledgements** We are extremely grateful to all families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientist, volunteers, managers, receptionists and nurses. The UK Medical Research Council and Wellcome (Grant ref: 102215/2/13/2) and the University of Bristol provide core support for ALSPAC. This manuscript is the work of the authors and Lamprini Psychogiou, Ginny Russell and Matthew Owens will serve as guarantors of the content of this manuscript.

## **Abstract**

The aim of the study was to examine whether parents' increased postnatal depressive symptoms predicted children's academic attainment over time, and whether the parent-child relationship, children's prior academic attainment and mental health mediated this association.

We conducted secondary analyses on the Avon Longitudinal Study of Parents and Children data (12,607 mothers, 9,456 fathers). Each parent completed the Edinburgh-Postnatal Depression Scale at 8 weeks after the child's birth (predictor) and a questionnaire about the mother-child and father-child relationship at 7 years and 1 month (mediator). The children's mental health problems were assessed with the teacher version of the Strengths and Difficulties Questionnaire at 10-11 years (mediator). We used data on the children's academic attainment on UK Key Stage 1 (5-7 years; mediator) and Key Stage 4 (General Certificate of Secondary Education (GCSE) 16 years) (outcome). We adjusted for the parents' education, and child gender and cognitive ability.

The results revealed that parents' depressive symptoms at 8 weeks predicted lower academic performance in children at 16 years. Mothers' postnatal depressive symptoms had an indirect effect through children's mental health problems on academic outcomes at 16 years via negative mother-child relationship, and prior academic attainment. There was a significant negative indirect effect of fathers' postnatal depressive symptoms on academic attainment at 16 years via negative father-child relationship on child mental health.

The findings suggest that the family environment (parental mental health and parent-child relationship) and children's mental health should be potential targets for support programmes for children of depressed parents.

**Key words:** ALSPAC, fathers, depressive symptoms, academic attainment, parent-child relationship, children's mental health

## **Introduction**

Academic attainment is associated with a range of positive outcomes in adulthood including better health and health related behaviours, greater social support, higher income, greater perceived control over one's life, and decreased odds of initiating drug use and delinquent behaviour (Bachman, 2008; Mirowsky & Ross, 2003; Ross & Wu, 1995). Several factors have been found to predict differences in educational attainment including individual, family, and sociodemographic characteristics (e.g., Pearson et al., 2016; Steinmayr & Spinath, 2008; Ou & Reynolds, 2008). Studies support the influence of parental depression on children's academic attainment (Augustine & Crosnoe, 2010). Shen et al. (2016) examined the association between mothers' and fathers' diagnoses of depression and their adolescent children's academic performance at 16 years using a sample of 1,124,162 Swedish children and found that depression in mothers and fathers at different time points independently predicted lower academic attainment in their children at 16 years.

It is key to understand the possible mechanisms by which a parent's depression lead to their child's low academic attainment in order to inform teachers and policy makers so that effective prevention and support programmes can be developed for students and their parents. In a longitudinal study of 50 mothers with postnatal depression and 39 controls, Murray et al. (2010) found that the association between mothers' postnatal depression and their sons' lower grades at 16 years was explained by the effects of mothers' postnatal depression on children's earlier cognitive ability and impaired mother-child interactions. Pearson et al. (2016) used data from the Avon Longitudinal Study of Parents and Children (ALSPAC; n=5,801) to examine links between mothers' and fathers' symptoms of depression when their children were 8 weeks, 8 months, 1.5 and 2.5 years old and their children's school grades at 16 years. They found that adolescent children of mothers with persistent postnatal depressive symptoms were less likely to get a "pass" grade than adolescents of mothers with low levels of depressive symptoms. There was evidence that executive functions measured in children at age 8 years could partially mediate some of the links between mothers' symptoms of depression and their children's academic attainment.

In addition to lower academic attainment, children of parents with depression are at increased risk for emotional and behavioural problems (Goodman et al., 2011; Gutierrez-Galve, Stein, Hanington et al., 2018; Netsi et al., 2018; Psychogiou et al., 2017; Ramchandani et al., 2005). Studies that tested cascading models show that mental health and academic attainment are interrelated and tend to influence each other over time (Masten et al., 2005). Using a sample of boys from low socio-economic status families, Moilanen, Shaw, and Maxwell (2010) found that boys with increased behavioural problems at age 6 and 8 years had lower academic competence two years later. The findings also revealed that poor academic competence predicted in turn behavioural problems at ages 11 and 12 and emotional symptoms at age 11. The authors argued that these findings provided support for the adjustment erosion hypothesis, according to which children's mental health problems predict academic underachievement and increase the risk for future psychopathology, and also the academic incompetence hypothesis, according to which academic underachievement predicts the onset and/or worsens existing mental health problems (e.g., Ansary, & Luthar, 2009; Masten et al., 2005; Maughan, Rowe, Loeber, & Stouthamer-Loeber, 2003; Morgan, Farkas, Tufis, & Sperling, 2008). In this study we aimed to examine potential mechanisms through which mothers' and fathers' symptoms of depression might exert their effects on their children's academic attainment.

The possible role of the mother-child and father-child relationship in explaining the effect of parental depression on children's academic attainment remains under-investigated. The existing literature indicates that the parent-child relationship influences academic attainment in children via several routes including children's willingness to internalise parental values about academic outcomes (Grusec & Goodnow, 1994; Kopystynska, Spinrad, Seay, & Eisenberg, 2016), and better problem solving and emotion regulation skills (Estrada, Arsenio, Hess, & Holloway, 1987; Gregory & Rimm-Kaufman, 2008). Another possible route is via children's mental health. It is established that parental depression predicts impairments in the parent-child relationship (Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Wilson, & Durbin, 2010). A study using the Millennium Cohort Data found a significant link between father's depressive symptoms and conflictual father-child relationship in the early years (Nath et al., 2015). In turn, impairments in the parent-child relationship have been found to predict children's emotional, behavioural and cognitive problems (Ahun &

Côté, 2018; Elgar et al., 2007; Malmberg, & Flouri, 2011; Nath et al., 2016). Building on these findings we aimed to examine if postnatal depressive symptoms have an indirect effect through children's mental health problems on academic outcomes at 16 years via a negative parent-child relationship.

Children's performance at the start of formal schooling might be another pathway via which parental depression may affect children's long-term academic attainment. During this developmental transition children experience significant changes in their daily lives for example, children begin to establish motivational, social and learning skills, and have to meet parents' and teachers' expectations about academic attainment (Masten et al., 2005; Stipek, 2001; Stipek & Miles, 2008). Based on the literature that links child mental health and academic attainment (e.g., Masten et al., 2005; Moilanen et al., 2010) it can be argued that children of parents with depression may do less well academically in the first grade and as a consequence they experience mental health difficulties which in turn predict academic performance over time. In other words, it is plausible that postnatal depressive symptoms would have an indirect effect through children's mental health problems on academic outcomes at 16 years via prior academic attainment. This study aimed to test that hypothesis.

Using data from the ALSPAC study, Pearson et al. (2016) demonstrated that mothers' symptoms of depression had an adverse effect on their children's academic attainment at age 16 years via children's executive functions. We extended the findings by Pearson and colleagues (2016) and used the ALSPAC dataset to examine whether children's mental health problems as measured by their behavioural and emotional difficulties have an indirect effect on academic attainment through negative parent-child relationship and prior academic attainment. We predicted that mothers' and fathers' depressive symptoms predict their children's academic attainment at age 16 years independent of parents' education, and children's gender, cognitive ability and prior academic attainment. Most importantly, we predicted that postnatal depressive symptoms in mothers and fathers have an indirect effect through children's mental health problems on academic outcomes at 16 years via negative parent-child relationship, and prior academic attainment while adjusting for parents' and children's characteristics (parents' education, and children's gender and cognitive ability).

## Methods

### *Participants*

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a population based birth cohort study based in South West England. ALSPAC recruited 14,541 pregnant women resident in Avon, UK with expected dates of delivery between 1st April 1991 to 31st December 1992. Of the initial 14,541 pregnancies, there were 14,062 live births and 13,988 children who were alive at 1 year of age. The initial cohort was broadly representative of the UK population at the 1991 census (Golding, Pembrey, & Jones, 2001). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Demographic details of the sample are described in more detail in the cohort profile papers (Boyd et al., 2013; Fraser et al., 2013). The study website also contains details of all the data that is available through a fully searchable data dictionary (<<http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/>>). When the oldest children were approximately 7 years of age, an attempt was made to boost the initial sample with eligible cases who had failed to join the study originally. As a result, when considering variables collected from the age of seven onwards data are available for more than the 14,541 pregnancies mentioned above. The data recorded for ALSPAC children and their parents were taken throughout their children's lives: ALSPAC has repeatedly taken detailed measures of mental health, cognition, development, social, and demographic factors from cohort members and their parents and these data are linked to educational data including academic outcomes. Figure 1 is a flow chart indicating sample size for the current study. Details of the ALSPAC ethics committee and further supporting documentation and a data search tool are available at [www.bristol.ac.uk/alspac](http://www.bristol.ac.uk/alspac).

[Insert Figure 1 here]

## Measures

### *Predictor*

*Parents' depressive symptoms (8 weeks after the child's birth).* Mothers' and fathers' depressive symptoms were measured using the 10 item Edinburgh-Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). Mothers and fathers reported on their depressive symptoms at 8 weeks after the child's birth. A total score is calculated by summing the scores on all 10 items. Higher scores indicate more severe symptoms. The EPDS has been administered in women to detect depression in the postnatal period (Cox et al., 1987) and has also been validated against the structural Clinical Interview for DSM-IV (SCID; Gorman et al., 2004) to detect fathers' depression after child's birth (sensitivity=89.5% and specificity=78.2%) (Edmondson, Psychogiou, Vlachos, Netsi, & Ramchandani, 2010).

### *Outcome*

*Children's academic attainment (16 years).* We used information on students' General Certificate of Secondary Education exams (Key Stage 4; KS4; ages 14-16 years). At KS4 students take their General Certificate of Secondary Education exams. Because at KS4 the number of subjects taken by each pupil can vary, we used the capped GCSE and equivalents points score available in the National Pupil Database (NPD). Here, grades for the top 8 GCSE results are converted to points and summed. In this way scores are comparable between pupils.

### *Mediators*

*Children's mental health (School Year 6: 10-11 years of age):* We measured children's mental health using the teacher version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The SDQ consists of 25 items which are divided into five subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationships and prosocial behaviour. All items are rated on a 3-point scale

ranging from 0 = *Not True* to 2 = *Certainly True*. A total problems score was created by summing all scores except the prosocial behaviour. Scores range from 0 to 40 with higher scores indicating greater problems. The SDQ has satisfactory reliability and validity (Goodman, 2001). For the purpose of the present study we used the total SDQ score.

*Children's prior academic attainment (7 years):* We measured children's prior academic attainment using children's grades obtained at Key Stage 1 (KS1; at 7 years). The main subjects at KS1 are reading, writing and maths and we used a summary score that combines these three tests.

*Parent-child relationship (7 years and 1 month).* The mother-child and father-child relationship was measured using parent's ratings. Mothers gave a 'yes', 'no' or 'sometimes' response to eight statements regarding their relationship with the study's child at age 7 years and 1 month. In previous studies (Dunn et al., 1998; Dunn et al., 1999; Roberts et al., 2004) four items were summed to create a "Positivity" scale (e.g., "I feel very close to this child") and the remaining items were summed to create a "Negativity" scale (e.g., "I often get irritated with this child"). Fathers also responded to the same eight statements to indicate their relationship with the study's child at 7 years and 1 month. In the present analysis, the original response format to the items on this scale ("Yes", "No" or "Sometimes") was recoded to "Yes" (including any instances of "Sometimes") and "No" to form a binary scale because frequencies of the "Sometimes" category were very low in some cases. One item ("Mother loves the study child") was dropped from the analysis as one category ("No") was endorsed in less than 0.1 % of cases. Confirmatory binary factor analysis (assuming 2 factors: negative and positive parent-child relationship) demonstrated a good fit to the data for mothers (CFI = 0.99; TLI = 0.99 RMSEA = 0.03 (90% CI 0.02 to 0.03) and fathers (CFI = 0.99; TLI = 0.99 RMSEA = 0.03 (90% CI 0.02 to 0.03). For the purpose of this study we focused on negative parent-child relationship as a mechanism of risk transmission.



## *Covariates*

Based on previous studies we adjusted for factors that have been associated with children's academic attainment including children's cognitive ability, gender and parents' education (Kuncel, Hezlett, & Ones, 2004; Murray et al., 2010; Pearson et al., 2016; Shen et al., 2016; Steinmayr & Spinath, 2008).

*Children's cognitive ability (8 years):* It was measured using the Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991). Trained researchers administered the test during a clinic visit when children were 8 years old. A total IQ score was used for the analyses with higher scores indicating better cognitive ability.

*Children's gender:* Children's gender was coded in a binary variable: 0 = Female or 1 = Male.

*Parents' education:* Mothers and fathers reported on their highest academic qualifications and an education variable was created for each parent: 1 = CSE, vocational and O-Level, 2 = A Level, 3 = University Degree.

## *Statistical Method*

Basic statistical analyses were run in STATA 14.2 and latent variable modelling was carried out in the Mplus programme, version 7.0. Our primary hypothesis was that maternal and paternal depressive symptoms (at 8 weeks) would be associated with lower academic scores in the child. Structural equation models (SEM) were specified with child academic attainment at 16 years (GCSE scores) as the outcome and parent's postnatal depressive symptoms as putative predictors of child academic attainment at 16 years. Child mental health problems, negative parent-child relationship, and prior academic attainment were included as potential mediators in the SEM for mothers and fathers. Parental

education, child gender and cognitive ability were all entered into the models as covariates. In the inferential analysis GCSE points scores (academic attainment at 16 years) were divided by 10 to ease computation of parameter estimates in Mplus.

Mediation in Mplus was evaluated using the product-of-coefficients strategy in the assessment of indirect effects (MacKinnon, Fairchild, & Fritz, 2007). Here ‘indirect effect’ and statistical mediation are synonymous. We requested 10,000 bootstrapped resamples and reported 95% bias-corrected confidence intervals which account for skew in the distribution of the samples of the product variable. Parental education was entered into the model as a categorical variable while postnatal symptoms of depression scores, child mental health problems, prior academic attainment were all entered as mean-centred covariates. In addition, an interaction term was created by calculating the product of mother and father depressive symptoms scores. Negative parent-child relationship was included in the model as a latent variable represented by the four binary items (“[Mother/Father] often gets irritated by study child”, “Mother/Father dislikes the mess and noise that surrounds the child”, “Mother/Father has frequent battle of will with study child”, “study child gets on Mother’s/Father’s nerves”). All other factors in the models were observed variables, indicated by a single measure and so latent variables were not required. Where appropriate, model fit was assessed using the root mean square error of approximation (RMSEA), the comparative fit index (CFI) and the Tucker-Lewis Index (TLI). A CFI and TLI value  $> 0.95$ , and RMSEA values  $< 0.06$  all suggest a good match between the hypothesised model and data collected (Hu & Bentler, 1999). Full information maximum likelihood (FIML) estimation was used where possible to account for missing data, which is a robust unbiased and efficient technique outperforming traditional approaches to missing data (Enders & Bandalos, 2001; Schafer & Graham, 2002). In the indirect effect models, bootstrapped bias-corrected standard errors were used which corrected for non-normality.

## Results

Descriptive statistics and correlations for key study variables can be found in Table 1.

[Insert Table 1 here]

An initial model was run showing the simple unadjusted relationship between parental depression and child GCSE scores for mothers ( $B = -0.14$ ,  $SE = 0.03$ ,  $p < .0001$ , 95% bias-corrected CI -0.19 to -0.09) and fathers ( $B = -0.07$ ,  $SE = 0.03$ ,  $p < .05$ , 95% bias-corrected CI -0.12 to -0.01) jointly.

### *Mothers' model*

The mediation model for mothers demonstrated an excellent fit to the data (CFI = 0.98; TLI = 0.97 RMSEA = 0.04 (90% CI 0.03 to 0.04)). This model explained 50% of the variance in child GCSE scores. In the mothers' model there were two significant negative indirect effects on academic attainment at 16 years both acting from maternal depressive symptoms, ultimately through children's mental health problems. The first was via negative mother-child relationship ( $B = -0.01$ ,  $SE = 0.002$ ,  $p < .001$ , 95% bias-corrected CI -0.014 to -0.007) and the second was via prior academic attainment ( $B = -0.004$ ,  $SE = 0.001$ ,  $p < 0.01$ , 95% bias-corrected CI -0.007 to -0.002).

### *Fathers' model*

The model for fathers was tested in an identical fashion to that of mothers and demonstrated a good fit to the data (CFI = 0.98; TLI = 0.98 RMSEA = 0.03 (90% CI 0.025 to 0.032)). There was a significant negative indirect effect of paternal postnatal depressive symptoms on academic attainment at 16 years via negative father-child relationship on child mental health problems ( $B = -0.008$ ,  $SE = 0.003$ ,  $p < .01$ , 95% bias-corrected CI -0.015 to -0.004) but not through prior academic attainment ( $B = -0.002$ ,  $SE =$

0.001,  $p = 0.211$ , 95% bias-corrected CI -0.005 to 0.001). Overall, 50% of the variance in GCSE scores was explained by all the paths in the fathers' model.

### *Mothers' and fathers' combined model*

This combined model was a good fit to the data and included a covariance between mothers' and fathers' depressive symptoms scores and between their respective negative parenting factors (CFI = 0.98; TLI = 0.97 RMSEA = 0.02 (90% CI 0.019 to 0.024). The indirect effect of postnatal depressive symptoms on academic attainment at 16 years was again found to be significant in this combined model for mothers (B = -0.007, SE = 0.002,  $p < .01$ , 95% bias-corrected CI -0.012 to -0.003) but not fathers (B = -0.004, SE = 0.003,  $p = .196$ , 95% bias-corrected CI -0.013 to -0.001). The interaction between mothers' and fathers' depressive symptoms on academic attainment at 16 years was not significant (B = -0.003, SE = 0.006,  $p = 0.623$ , 95% bias-corrected CI -0.016 to 0.009). This combined model explained 51% of variance in GCSE scores at 16 years. Parameter estimates for the final combined model are illustrated in Figure 2.

[Insert Figure 2 here]

## **Discussion**

The findings show that higher depressive symptoms in mothers in the postnatal period were significantly associated with lower academic attainment in their children at 16 years. We also found significant associations between fathers' depressive symptoms and their children's academic attainment at 16 years. The finding documenting a significant link between parents' symptoms of depression and children's academic attainment is consistent with previous studies (Murray et al., 2010; Pearson et al., 2016; Shen et al., 2016). In support of the second hypothesis, in the single model for mothers we found a dual pathway from mother's postnatal depressive symptoms to academic attainment at 16 years via negative parent-child

relationship and lower early academic attainment on child's mental health. In other words, mother's postnatal depressive symptoms influenced the mother-child relationship and prior academic attainment directly. These two pathways contributed to increased child mental health problems which subsequently predicted academic attainment at 16 years. In the single model for fathers there was a significant negative indirect effect of paternal postnatal depressive symptoms on academic attainment at 16 years via negative father-child relationship on child mental health problems but not through prior academic attainment. Therefore it appears that across both parents a negative parent-child relationship may pose a risk factor for their children's long-term academic attainment. Previous studies have found that the quality of the mother-child relationship contributes to children's academic attainment (Fraley, Roisman, & Haltigan, 2013) and the few existing studies considering both parents have provided some evidence for the role of fathers in their children's academic outcomes too (Putnick et al. 2015; Suizzo et al., 2016). Our findings show that among children of parents with postnatal depressive symptoms a negative parent-child relationship contributes to increased child mental health symptoms and subsequent academic underachievement.

A second pathway from mothers' symptoms of depression to lower academic attainment at 16 years was via prior academic attainment on children's mental health. Previous studies show that children's attainment when they start school can have long-lasting effects and can predict academic outcomes up to adolescence and early adulthood (Cunningham & Stanovich, 1997; Duncan et al., 2007; Entwisle et al., 2005; Stipek, 2001). The findings of this study suggest that children of mothers with increased symptoms of postnatal depression may achieve lower grades at 7 years and they may enter on trajectories of academic underachievement up to 16 years via mental health difficulties. An interesting direction for future research concerns the mechanisms by which mental health problems may affect children's later academic performance. Some mechanisms include rejection by teachers and classmates, affiliation with deviant peers, limited involvement in learning activities, and attention deficits (Breslau et al., 2009; Dishion, 1990; Masten et al., 2005; McLeod & Kaiser, 2004; Moilanen et al., 2010; Roeser, van der Wolf, & Strobel, 2001). It is also important to examine if the mechanisms of risk transmission are different between emotional and behavioural problems. Better understanding of these possible mechanisms is key to the development of

prevention and intervention strategies that may have the potential to disrupt negative academic trajectories in at risk children.

The pathway from fathers' symptoms of depression to lower academic attainment at 16 years via prior academic attainment on children's mental health was not significant. It is worth mentioning that all the paths explained 50% of the variance in GCSE scores for the mothers' model and 50% of the variance in GCSE scores for the fathers' model providing some evidence for the equal influence of mothers' and fathers' depressive symptoms on their children's academic attainment. When we adopted a more integrative approach and included both mothers' and fathers' depressive symptoms in the same model we found no support for a significant interaction between mothers' and fathers' depressive symptoms in predicting their children's academic attainment. In this combined model (Figure 2) there was support for mediation for negative mother-child relationship only. Given that maternal and paternal depression are positively associated (e.g., Paulson & Bazemore, 2010) an interesting pathway to test in future studies is whether paternal depression influences maternal depression which in turn impacts negatively on the mother-child relationship and child's outcomes.

Before discussing the implications of the study's findings, a number of strengths and limitations should be considered. The study had a large sample size that is representative of the population in the United Kingdom, employed a prospective design, had data on depressive symptoms on both mothers and fathers and used teachers' reports on children's mental health. However, the study also had a number of limitations. The parents' levels of depressive symptoms were low (8 weeks EPDS mean of 6.06 for mothers and 3.80 for fathers) to test the proposed theoretical model effectively and there were no available data on parents' clinical diagnoses of depression. Both mother-child and father-child relationship were measured by self-reports which might have been biased by parent's mood (Chi & Hinshaw, 2002). The study focused on negative parent-child relationship, but other dimensions and/or parenting behaviours might have a stronger influence on children's academic attainment. In particular, how depressed parents scaffold their children's learning is an important direction for future research. The study provided support for significant effects of parental depressive symptoms on their children's academic outcomes over time, but these findings should be

interpreted with caution. While a strength of this study is its use of longitudinal data allowing us to assess change over time and to test for potential mediating variables, further experimental evidence including the use of randomised controlled trial methodology, should be gathered before more concrete conclusions can be drawn. An interesting direction for future research is to examine if interventions that target parental depressive symptoms have any effects on their children's academic attainment. In addition, other pathways, both genetic and environmental that were not examined in this study could explain the observed associations. As children get older other important relationships (e.g., support from peers and teachers) might play a pivotal role in their educational performance (Kiuru et al., 2014). Also other school related outcomes (e.g., school dropout, repeat grades, bullying) should be examined. Finally, while the study focused on parents' depressive symptoms in the postnatal period future research should examine if mothers' symptoms of depression in the antenatal period predict their children's academic attainment.

Despite these limitations, the findings have important implications. Given the negative influence of parental depressive symptoms on the parent-child relationship and children's outcomes prevention and intervention strategies should target parental postnatal depressive symptoms. Screening for parents' depression in the early years of a child's life could be extended to fathers so long as there are resources available to support parents with depression (Nath et al., 2015). Parenting interventions could aim to improve the parent-child relationship and test if any changes contribute positively to children's academic attainment. Educational campaigns could provide information to families, teachers and policy makers and highlight the possible role of parents' and children's mental health and family environment in having long lasting effects on children's academic attainment (Galler et al., 2004). Given the key role of children's academic problems early on in predicting later outcomes (Chen et al., 1996; Cunningham & Stanovich, 1997; Duncan et al., 2007; Entwisle et al., 2005; Stipek, 2001), support programmes could continue to identify and support students with limited academic skills. In summary, the findings provide support for a dual pathway from mothers' postnatal depressive symptoms to academic attainment at 16 years via negative mother-child relationship and lower early academic attainment on children's mental health. There was also a

significant negative indirect effect of fathers' postnatal depressive symptoms on academic attainment at 16 years via negative father-child relationship on children's mental health.



## References

- Ahun, M. N., & Côté, S. M. (2018). Maternal depressive symptoms and early childhood cognitive development: a review of putative environmental mediators. *Archives of Women's Mental Health*.  
oi.org/10.1007/s00737-018-0870-x
- Ansary, N. S., & Luthar, S. S. (2009). Distress and academic achievement among adolescents of affluence: A study of externalizing and internalizing problem behaviors and school performance. *Development and Psychopathology, 21*, 319-341. doi:10.1017/S0954579409000182
- Augustine, J.M., & Crosnoe, R. (2010). Mothers' depression and educational attainment and their children's academic trajectories. *Journal of Health and Social Behavior, 51*, 274-290. DOI: 10.1177/0022146510377757
- Bachman, J. G. (2008). *The education-drug use connection: How successes and failures in school relate to adolescent smoking, drinking, drug use, and delinquency*. Psychology Press.
- Boyd, A., Golding, J., Macleod, J., Lawlor, D.A., Fraser, A., Henderson, J., ...Davey Smith, G. (2013). Cohort profile: the 'children of the 90s'—the index offspring of the Avon Longitudinal Study of Parents and Children. *International Journal of Epidemiology, 42*, 111-127. doi:10.1093/ije/dys064
- Breslau, J., Miller, E., Breslau, N., Bohnert, K., Lucia, V., & Schweitzer, J. (2009). The impact of early behavior disturbances on academic achievement in high school. *Pediatrics, 123*, 1472-1476. doi:10.1542/peds.2008-1406.
- Chen, C., Lee, S.Y., & Stevenson, H.W. (1996). Long-term prediction of academic achievement of American, Chinese, and Japanese adolescents. *Journal of Educational Psychology, 88*, 750-759.
- Chi, T.C., & Hinshaw, S.P. (2002). Mother-child relationships of children with ADHD: The role of maternal depressive symptoms and depression-related distortions. *Journal of Abnormal Child Psychology, 30*, 387-400.
- Cox, J.L., Holden, J.M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *The British Journal of Psychiatry, 150*, 782-786.

- Cunningham, A.E., & Stanovich, K.E. (1997). Early reading acquisition and its relation to reading experience and ability 10 years later. *Developmental Psychology, 33*, 934-945. doi/10.1037/0012-1649.33.6.934
- Dishion, T. J. (1990). The family ecology of boys' peer relations in middle childhood. *Child Development, 61*, 874-892. DOI: 10.1111/j.1467-8624.1990.tb02829.x
- Duncan, G.J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., ... & Sexton, H. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428-1446. DOI: 10.1037/0012-1649.43.6.1428
- Dunn, J., Deater-Deckard, K., Pickering, K., & Golding, J. (1999). Siblings, parents, and partners: Family relationships within a longitudinal community study. *Journal of Child Psychology and Psychiatry, 40*, 1025-1037.
- Dunn, J., Deater-Deckard, K., Pickering, K., O'Connor, T.G., & Golding, J. (1998). Children's adjustment and prosocial behaviour in step-, single-parent, and non-stepfamily settings: Findings from a community study. *Journal of Child Psychology and Psychiatry, 39*, 1083-1095.
- Edmondson, O.J., Psychogiou, L., Vlachos, H., Netsi, E., & Ramchandani, P.G. (2010). Depression in fathers in the postnatal period: assessment of the Edinburgh Postnatal Depression Scale as a screening measure. *Journal of Affective Disorders, 125*, 365-368. doi:10.1016/j.jad.2010.01.069
- Elgar, F. J., Mills, R. S., McGrath, P. J., Waschbusch, D. A., & Brownridge, D. A. (2007). Maternal and paternal depressive symptoms and child maladjustment: The mediating role of parental behavior. *Journal of Abnormal Child Psychology, 35*, 943-955. DOI 10.1007/s10802-007-9145-0
- Enders, C.K., & Bandalos, D.L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling, 8*, 430-457. doi.org/10.1207/S15328007SEM0803\_5
- Entwisle, D.R., Alexander, K.L., & Olson, L.S. (2005). First Grade and Educational Attainment by Age 22: A New Story<sup>1</sup>. *American Journal of Sociology, 110*, 1458-1502. doi.org/10.1086/428444

- Estrada, P., Arsenio, W.F., Hess, R.D., & Holloway, S.D. (1987). Affective quality of the mother–child relationship: Longitudinal consequences for children's school-relevant cognitive functioning. *Developmental Psychology, 23*, 210-215.
- Fraley, R.C., Roisman, G.I., & Haltigan, J.D. (2013). The legacy of early experiences in development: Formalizing alternative models of how early experiences are carried forward over time. *Developmental Psychology, 49*, 109-126. DOI: 10.1037/a0027852
- Fraser, A., Macdonald-Wallis, C., Tilling, K., Boyd, A., Golding, J., Davey Smith, G., ... & Ring, S. (2013). Cohort profile: the Avon Longitudinal Study of Parents and Children: ALSPAC mothers cohort. *International Journal of Epidemiology, 42*, 97-110. doi:10.1093/ije/dys066
- Galler, J.R., Ramsey, F.C., Harrison, R.H., Taylor, J., Cumberbatch, G., & Forde, V. (2004). Postpartum maternal moods and infant size predict performance on a national high school entrance examination. *Journal of Child Psychology and Psychiatry, 45*, 1064-1075. DOI: 10.1111/j.1469-7610.2004.t01-1-00299.x
- Golding, J., Pembrey, M., & Jones, R. (2001). ALSPAC--the Avon Longitudinal Study of Parents and Children. I. Study methodology. *Paediatric and Perinatal Epidemiology, 15*, 74–87. DOI: 10.1046/j.1365-3016.2001.00325.x
- Goodman, R. (2001). Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*, 1337-1345. doi.org/10.1097/00004583-200111000-00015
- Goodman, R. (1997). The Strengths and Difficulties Questionnaire: a research note. *Journal of Child Psychology and Psychiatry, 38*, 581-586. DOI: 10.1111/j.1469-7610.1997.tb01545.x
- Goodman, S.H., Rouse, M.H., Connell, A.M., Broth, M.R., Hall, C.M., & Heyward, D. (2011). Maternal depression and child psychopathology: A meta-analytic review. *Clinical Child and Family Psychology Review, 14*, 1-27. DOI 10.1007/s10567-010-0080-1
- Gorman, L.L., O'Hara, M.W., Figueiredo, B., Hayes, S., Jacquemain, F., Kammerer, M.H., ... & Sutter-Dallay, A.L. (2004). Adaptation of the Structured Clinical Interview for DSM–IV Disorders for

assessing depression in women during pregnancy and post-partum across countries and cultures.

*The British Journal of Psychiatry*, 184, s17-s23. DOI: 10.1192/bjp.184.46.s17

Gregory, A., & Rimm-Kaufman, S. (2008). Positive mother-child interactions in kindergarten:

Predictors of school success in high school. *School Psychology Review*, 37, 499-515.

Grusec, J.E., & Goodnow, J.J. (1994). Impact of parental discipline methods on the child's

internalization of values: A reconceptualization of current points of view. *Developmental*

*Psychology*, 30, 4-19. doi/10.1037/0012-1649.30.1.4

Gutierrez-Galve, L., Stein, A., Hanington, L., Heron, J., Lewis, G., O'Farrelly, C., & Ramchandani, P.

G. (2018). Association of Maternal and Paternal Depression in the Postnatal Period With

Offspring Depression at Age 18 Years. *JAMA Psychiatry*. doi:10.1001/jamapsychiatry.2018.3667

Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis:

Conventional criteria versus new alternatives. *Structural Equation Modeling: a Multidisciplinary*

*Journal*, 6, 1-55. DOI:10.1080/10705519909540118

Kiuru, N., Pakarinen, E., Vasalampi, K., Silinskas, G., Aunola, K., Poikkeus, A.M., ... & Nurmi, J.E.

(2014). Task-focused behavior mediates the associations between supportive interpersonal

environments and students' academic performance. *Psychological Science*, 25, 1018-1024. DOI:

10.1177/0956797613519111

Kopystynska, O., Spinrad, T.L., Seay, D.M., & Eisenberg, N. (2016). The interplay of maternal

sensitivity and gentle control when predicting children's subsequent academic functioning:

Evidence of mediation by effortful control. *Developmental Psychology*, 52, 909-921.

doi.org/10.1037/dev0000122

Kuncel, N.R., Hezlett, S.A., & Ones, D.S. (2004). Academic performance, career potential, creativity,

and job performance: Can one construct predict them all?. *Journal of Personality and Social*

*Psychology*, 86, 148-161. DOI: 10.1037/0022-3514.86.1.148

- Lovejoy, M. C., Graczyk, P. A., O'Hare, E., & Neuman, G. (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review, 20*, 561-592.  
doi.org/10.1016/S0272-7358(98)00100-7
- MacKinnon, D.P., Fairchild, A.J., & Fritz, M.S. (2007). Mediation analysis. *Annual Review of Psychology, 58*, 593-614. doi.org/10.1146/annurev.psych.58.110405.085542
- Malmberg, L. E., & Flouri, E. (2011). The comparison and interdependence of maternal and paternal influences on young children's behavior and resilience. *Journal of Clinical Child and Adolescent Psychology, 40*, 434-444. DOI: 10.1080/15374416.2011.563469
- Masten, A.S., Roisman, G.I., Long, J.D., Burt, K.B., Obradović, J., Riley, J.R., ...& Tellegen, A. (2005). Developmental cascades: linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental Psychology, 41*, 733-746. doi/10.1037/0012-1649.41.5.733
- Maughan, B., Rowe, R., Loeber, R., & Stouthamer-Loeber, M. (2003). Reading problems and depressed mood. *Journal of Abnormal Child Psychology, 31*, 219-229.
- McLeod, J. D., & Kaiser, K. (2004). Childhood emotional and behavioral problems and educational attainment. *American Sociological Review, 69*, 636-658.
- Mirowsky, J., & Ross, C. E. (2003). *Education, social status, and health*. Transaction Publishers.
- Moilanen, K. L., Shaw, D. S., & Maxwell, K. L. (2010). Developmental cascades: Externalizing, internalizing, and academic competence from middle childhood to early adolescence. *Development and Psychopathology, 22*, 635-653. doi.org/10.1017/S0954579410000337
- Morgan, P. L., Farkas, G., Tufis, P. A., & Sperling, R. A. (2008). Are reading and behavior problems risk factors for each other?. *Journal of learning disabilities, 41*(5), 417-436.
- Murray, L., Arteche, A., Fearon, P., Halligan, S., Croudace, T., & Cooper, P. (2010). The effects of maternal postnatal depression and child sex on academic performance at age 16 years: a developmental approach. *Journal of Child Psychology and Psychiatry, 51*, 1150-1159.  
doi:10.1111/j.1469-7610.2010.02259.x

- Nath, S., Russell, G., Ford, T., Kuyken, W., & Psychogiou, L. (2015). Postnatal paternal depressive symptoms associated with fathers' subsequent parenting: findings from the Millennium Cohort Study. *The British Journal of Psychiatry*, *207*, 558-559. DOI: 10.1192/bjp.bp.114.148379
- Nath, S., Russell, G., Kuyken, W., Psychogiou, L., & Ford, T. (2016). Does father-child conflict mediate the association between fathers' postnatal depressive symptoms and children's adjustment problems at 7 years old?. *Psychological Medicine*, *46*, 1719-1733.  
doi:10.1017/S0033291716000234
- Netsi, E., Pearson, R. M., Murray, L., Cooper, P., Craske, M. G., & Stein, A. (2018). Association of persistent and severe postnatal depression with child outcomes. *JAMA Psychiatry*, *75*, 247-253.  
doi:10.1001/jamapsychiatry.2017.4363
- Ou, S.R., & Reynolds, A.J. (2008). Predictors of educational attainment in the Chicago Longitudinal Study. *School Psychology Quarterly*, *23*, 199-229. DOI: 10.1037/1045-3830.23.2.199
- Paulson, J. F., & Bazemore, S. D. (2010). Prenatal and postpartum depression in fathers and its association with maternal depression: a meta-analysis. *JAMA Psychiatry*, *303*, 1961-1969.  
doi:10.1001/jama.2010.605
- Pearson, R.M., Bornstein, M.H., Cordero, M., Scerif, G., Mahedy, L., Evans, J., ... & Stein, A. (2016). Maternal perinatal mental health and offspring academic achievement at age 16: the mediating role of childhood executive function. *Journal of Child Psychology and Psychiatry*, *57*, 491-501.  
doi:10.1111/jcpp.12483
- Psychogiou, L., Moberly, N. J., Parry, E., Nath, S., Kallitsoglou, A., & Russell, G. (2017). Parental depressive symptoms, children's emotional and behavioural problems, and parents' expressed emotion—Critical and positive comments. *PloS one*, *12*(10), e0183546.
- Putnick, D.L., Bornstein, M.H., Lansford, J.E., Malone, P.S., Pastorelli, C., Skinner, A.T., ...& Alampay, L.P. (2015). Perceived mother and father acceptance-rejection predict four unique aspects of child adjustment across nine countries. *Journal of Child Psychology and Psychiatry*, *56*, 923-932. doi:10.1111/jcpp.12366

- Ramchandani, .P, Stein, A., Evans, J., O'Connor, T.G., & ALSPAC Study Team. (2005). Paternal depression in the postnatal period and child development: a prospective population study. *The Lancet*, 365, 2201-2205. doi.org/10.1016/S0140-6736(05)66778-5
- Roberts, R., O'Connor, T., Dunn, J., Golding, J., & ALSPAC Study Team (2004). The effects of child sexual abuse in later family life; mental health, parenting and adjustment of offspring. *Child Abuse and Neglect*, 28, 525-545. doi:10.1016/j.chiabu.2003.07.006
- Roeser, R. W., van der Wolf, K., & Strobel, K. R. (2001). On the relation between social–emotional and school functioning during early adolescence: Preliminary findings from Dutch and American samples. *Journal of School Psychology*, 39, 111-139. doi.org/10.1016/S0022-4405(01)00060-7
- Ross, C.E., & Wu, C.L. (1995). The links between education and health. *American Sociological Review*, 60, 719-745.
- Schafer, J.L., & Graham, J.W. (2002). Missing data: our view of the state of the art. *Psychological Methods*, 7, 147-177. doi/10.1037/1082-989X.7.2.147
- Shen, H., Magnusson, C., Rai, D., Lundberg, M., Lê-Scherban, F., Dalman, C., & Lee, B.K. (2016). Associations of parental depression with child school performance at age 16 years in Sweden. *Journal of the American Medical Association Psychiatry*, 73, 239-246. doi:10.1001/jamapsychiatry.2015.2917
- Steinmayr, R., & Spinath, B. (2008). Sex differences in school achievement: What are the roles of personality and achievement motivation?. *European Journal of Personality*, 22, 185-209. DOI: 10.1002/per.676
- Stipek, D. (2001). Pathways to constructive lives: The importance of early school success. In A. Bohart & D. Stipek (Eds). *Constructive and destructive behavior. Implications for family, school and society* (pp. 291-315). American Psychological Association, Washington, DC.
- Stipek, D., & Miles, S. (2008). Effects of aggression on achievement: Does conflict with the teacher make it worse?. *Child Development*, 79, 1721-1735. DOI: 10.1111/j.1467-8624.2008.01221.x

- Suizzo, M.A., Rackley, K.R., Robbins, P.A., Jackson, K.M., Rarick, J.R., & McClain, S. (2016). The Unique Effects of Fathers' Warmth on Adolescents' Positive Beliefs and Behaviors: Pathways to Resilience in Low-Income Families. *Sex Roles, 77*, 46-58. DOI 10.1007/s11199-016-0696-9
- Wechsler, D. (1991). Manual for Wechsler Intelligence Scale for children-Revised. San Antonio, TX: Psychological Corporation.
- Wilson, S., & Durbin, C. E. (2010). Effects of paternal depression on fathers' parenting behaviors: A meta-analytic review. *Clinical Psychology Review, 30*, 167-180. doi:10.1016/j.cpr.2009.10.007



Table 1. Descriptive statistics and correlations between study variables.

Variables (mean, SD)	1	2	3	4	5	6	7	8	9	10
1. Mother's depression (EPDS) 6.06 (4.80)	–									
2. Father's depression (EPDS) 3.80 (3.85)	0.27***	–								
3. Mother's education <sup>a</sup>	-0.02*	0.01	–							
4. Father's education <sup>b</sup>	-0.04*	0.00	0.54***	–						
5. Mother-child relationship <sup>c</sup>	0.11***	0.07***	-0.16***	-0.12***	–					
6. Father-child relationship <sup>c</sup>	0.07***	0.08***	-0.19***	-0.18***	0.51***	–				
7. Child gender <sup>d</sup>	-0.01	0.00	0.01	0.00	-0.00	-0.01	–			
8. Child IQ (WISC-III) 103.98 (16.54)	-0.06***	-0.03*	0.34***	0.33***	-0.16***	-0.17***	-0.01	–		
9. Child mental health (SDQ) 5.85 (6.00)	0.07***	0.05**	-0.10***	-0.12***	0.20***	0.14***	-0.25***	-0.27***	–	
10. Academic attainment (KS1) <sup>e</sup> 9.10 (3.76)	-0.09***	-0.05***	0.26***	0.26***	-0.27***	-0.22***	0.13***	0.63***	-0.44***	–
11. Academic attainment (GCSE) <sup>f</sup> 315.28 (96.11)	-0.09***	-0.04***	0.35***	0.35***	-0.25***	-0.24***	0.12***	0.58***	0.46***	0.64***

Note: <sup>a</sup> Mother's education: 1 = CSE, vocational and O-Level 7,307 (62%), 2 = A-Level 2,801 (24%), 3 = Degree 1,609 (14%) <sup>b</sup> Father's education: 1 = CSE, vocational and O-Level 4,581(49%) 2 = A-Level 2,777 (30%) 3 = Degree 1,938 (21%) <sup>c</sup> Parent-child relationship variables (both Mother and Father) are summed scores. Model-based latent variables were used in the analysis. <sup>d</sup>Child gender: 0 = Female 7,219 (48.60%). 1 = Male 7635 (51.40%), <sup>e</sup> KS1 exams are sat at 7 years old. <sup>f</sup> GCSE exams are sat at 16 years old. EPDS = Edinburgh-Postnatal Depression Scale; SDQ = Strengths and Difficulties Questionnaire (teachers' reports); CSE = Certificate of Secondary Education; GCSE = General Certificate of Secondary Education; KS1 = Key Stage 1; WISC-III = Wechsler Intelligence Scale for Children-III. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

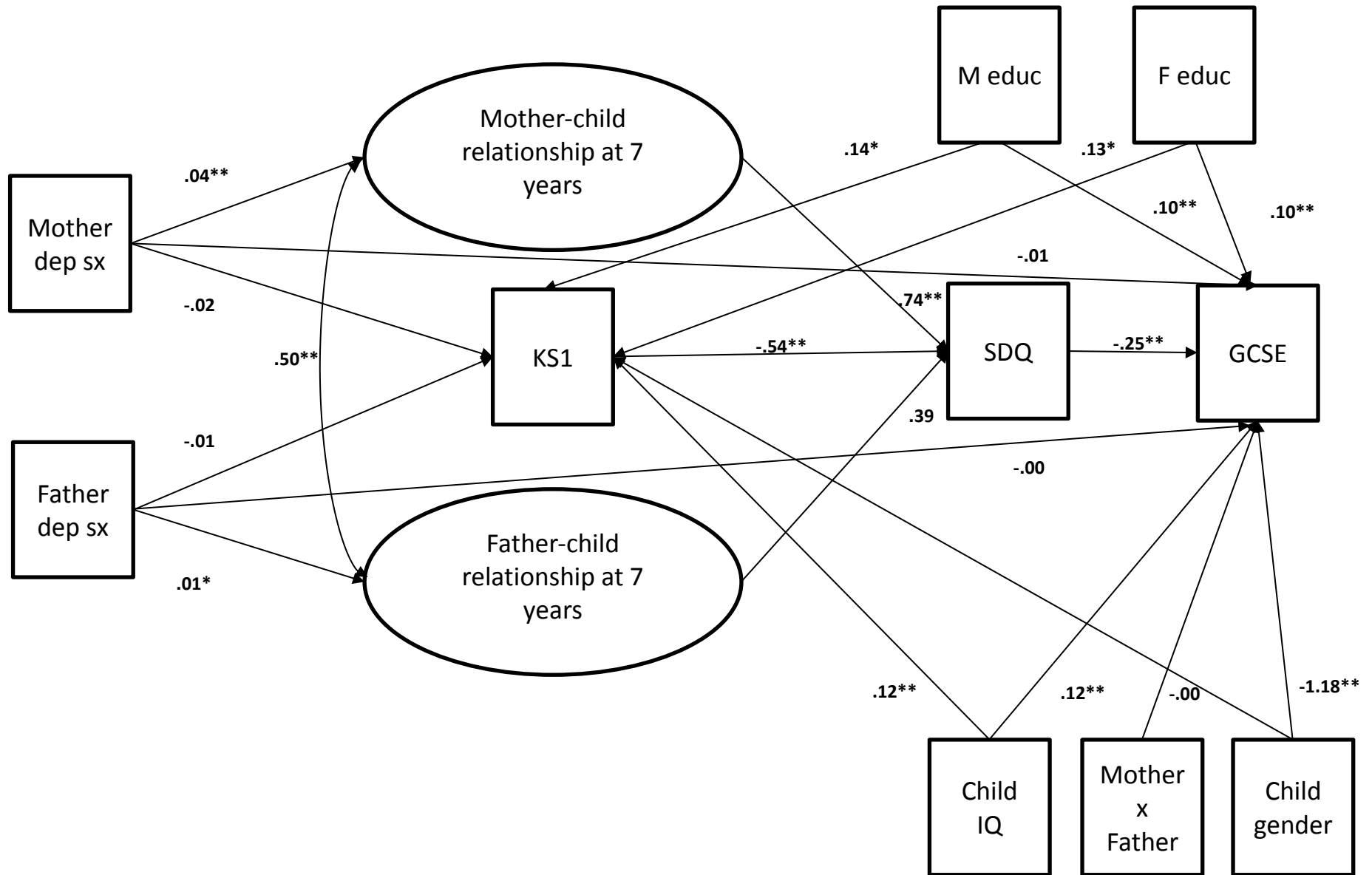


Figure 2. The final joint father/mother structural equation model.

Note. Mother dep sx = Mother EPDS score at 8 weeks; Father dep sx = Father EPDS score at 8 weeks; Mother/Father child relationship at 7 years = latent variable comprised of 4 binary items: irritate = “[Mother/Father] often gets irritated by study child”, “Mother/Father dislikes the mess and noise that surrounds the child”, battle = “Mother/Father has frequent battle of will with study child”, nerves = “study child gets on Mother’s/Father’s nerves”. KS1 = Key Stage 1; SDQ = Strengths and Difficulties Questionnaire (teachers’ reports); GCSE exams are sat at 16 years old. M educ/F educ = educational level for parents, GCSE, A-Level or University Degree; Child IQ = Wechsler Intelligence Scale for Children-III; Child gender = 0 = Female 1 = Male; Mother x Father = interaction term for Mother and Father EPDS scores at 8 weeks. \* =  $p < .05$ , \*\* =  $p < .01$ .