

Parental suicide attempt and offspring educational attainment during adolescence in the Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort

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Background. Few studies have investigated the impact of parental suicide attempt (SA) on offspring outcomes other than mental health. We investigated the association of parental SA with offspring educational attainment in the Avon Longitudinal Study of Parents and Children (ALSPAC).

Method. Parental SA was prospectively recorded from pregnancy until the study children were 11 years old. National school test results (ages 11–16 years) were obtained by record linkage. Multilevel regression models quantified the association between parental SA and offspring outcomes.

Results. Data were available for 6667 mother–child and 3054 father–child pairs. Adolescents whose mothers had attempted suicide were less likely than their peers to achieve the expected educational level by age 14 years [adjusted odds ratio (aOR) 0.63, 95% confidence interval (CI) 0.41–0.95] in models controlling for relevant confounders, including parental education and depression. At age 16 years, adolescents whose mothers had attempted suicide were less likely to obtain the expected educational level (five or more qualifications at grade A*–C) (aOR 0.66, 95% CI 0.43–1.00) in models controlling for relevant confounders and parental education; however, after additionally controlling for maternal depression the results were consistent with chance (aOR 0.74, 95% CI 0.48–1.13). Findings in relation to paternal SA were consistent with those of maternal SA but power was limited due to lower response rate amongst fathers.

Conclusions. Maternal SA was associated with diminished educational performance at age 14 years. Educational attainment during adolescence can have substantial effect on future opportunities and well-being and these offspring may benefit from interventions.

Received 14 April 2015; Revised 22 January 2016; Accepted 20 February 2016; First published online 11 April 2016

Key words: Avon Longitudinal Study of Parents and Children, birth cohorts, child academic performance, longitudinal studies, parental self-harm.

Introduction

Each year about 800 000 people die by suicide worldwide (World Health Organization, 2014). It has been estimated that for every suicide six people suffer intense grief (Clark & Goldney, 2000); thus about five million people are bereaved each year through suicide, but no precise data on the number of children who lose a parent through suicide are available. A study based in the USA estimated that 10 000–20 000 children and adolescents lose a parent to suicide each year in the USA (Pfeffer, 2000) and in Britain, data from the 1970s suggested that approximately 2000 children

under 16 years are thought to be bereaved by parental suicide annually (Shepherd & Barraclough, 1976). For each completed suicide at least 20 individuals attempt suicide (World Health Organization, 2014), so every year as many as 400 000 children in the USA and 40 000 in Britain may be exposed to non-fatal suicidal acts by their parents.

A number of studies have reported that offspring exposed to parental suicidal behaviours (suicide or suicide attempt; SA) are at increased risk of psychopathology, most notably, suicidal behaviours and affective disorders (Geulayov *et al.* 2012) but little is known about the impact of parental suicidal behaviours on other aspects of their offspring's well-being. Education has a range of economic, social and health benefits which are important for an individual's well-being (Ou & Reynolds, 2008). Educational attainment during adolescence is important for an individual's

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prospects in terms of their ability to access further education and training as well as their future employability and social participation (Petrides *et al.* 2004). Very little is known about the relationship between parental suicidal behaviours and offspring educational attainment. A study by Brent *et al.* (2012) found diminished developmental competence (which included some educational indices such as educational aspirations) among offspring exposed to sudden parental death (suicide, sudden natural death and accidents). The investigators reported that there was no relationship between the cause of death and any of the outcomes assessed. Furthermore, Berg *et al.* (2014) examined the impact of parental death due to natural and external (suicide, accidents and violence) causes on school success, reporting that parental death due to natural and external causes was associated with lower mean school grades. Furthermore, a small body of research evidence shows that exposure to parental psychopathology such as maternal postnatal depression is associated with adverse developmental and academic outcomes (Hay *et al.* 2001, 2008; Grace *et al.* 2003; Murray *et al.* 2010).

Research has suggested that the impact of maternal suicidal behaviour on offspring outcomes may differ from that of paternal suicidal behaviour, and that sons and daughters may be differently affected by suicidal behaviour of their parents (Geulayov *et al.* 2012). Offspring age at exposure to parental suicidal behaviours may also modify the association between parental suicidal behaviours and offspring outcomes, with limited existing data pointing to heightened vulnerability of those exposed at younger ages (Tsuchiya *et al.* 2005; Wilcox *et al.* 2010), particularly those exposed during early childhood (up to 5 years) (Kuramoto *et al.* 2013).

This study investigates the association of parental SA with offspring educational attainment in adolescence in a large prospective cohort – the Avon Longitudinal Study of Parents and Children (ALSPAC). We use standard national assessment tests to measure level of educational attainment. We also investigated whether the associations differ depending on the sex of the parent who attempted suicide or the offspring and the age of exposure to parental SA.

Method

Study population

Our analysis is based on ALSPAC (<http://www.alspac.bris.ac.uk>). The study is described in detail elsewhere (Golding *et al.* 2001; Boyd *et al.* 2013; Fraser *et al.* 2013). In summary, ALSPAC is a UK-based multigeneration prospective cohort study of the health and

development of children. Initially, 14 541 pregnant women living in the former County of Avon (the area around Bristol and Bath in southwest England) whose expected delivery date was in 1991–1992 were invited to take part (Golding *et al.* 2001; Ness, 2004). Altogether 13 796 offspring were singletons or first-born twins and were alive at 1 year of age (Fig. 1). Extensive data have been collected from the mothers, fathers and their offspring from pregnancy onwards by questionnaire, abstraction from medical notes, record linkage and by attendance at assessment clinics. The study website contains details of all the data that are available through a fully searchable data dictionary (Avon Longitudinal Study of Parents and Children, 2014).

Participants

We included mother–offspring and father–offspring pairs if the parent had provided sufficient information on SA (see below), the child had data on academic performance at age 11–16 years [i.e. Key stage 3 (KS3) and Key stage 4 (KS4) results] and gave their consent to use their data. Of the 13 796 offspring considered for analysis, 6667 mother–child and 3054 father–child pairs were included in the analytic sample (see Fig. 1).

Measures

Parental SA was identified through a 41-item parent-completed life-event questionnaire sent to parents on 10 separate occasions from before the study child's birth until they were 11 years old. In each assessment, parents were asked about a specified period of time which covered the period from the previous assessment so that the 10 questionnaires covered the whole period from 18 weeks of gestation up to when the child was 11 years old. For example, at 18 weeks of gestation, parents were asked whether they had experienced any of a list of 41 life events 'since becoming pregnant'; for SA the life event statement was worded as 'You attempted suicide'. The questionnaires were sent to the parents at 18 weeks of gestation and then when the study children were 2, 8, 21, 37, 47, 61, 73, 110 and 134 months old. After a careful consideration of response and missing data patterns to this question and the potential consequences of misclassification resulting from including individuals with different levels of missing data, we decided to employ a conservative approach whereby we excluded parents who completed fewer than seven of these assessments as we were concerned we may otherwise misclassify a substantial proportion of parents who had attempted suicide as non-attempters. Parents who responded positively to the SA question at any assessment were

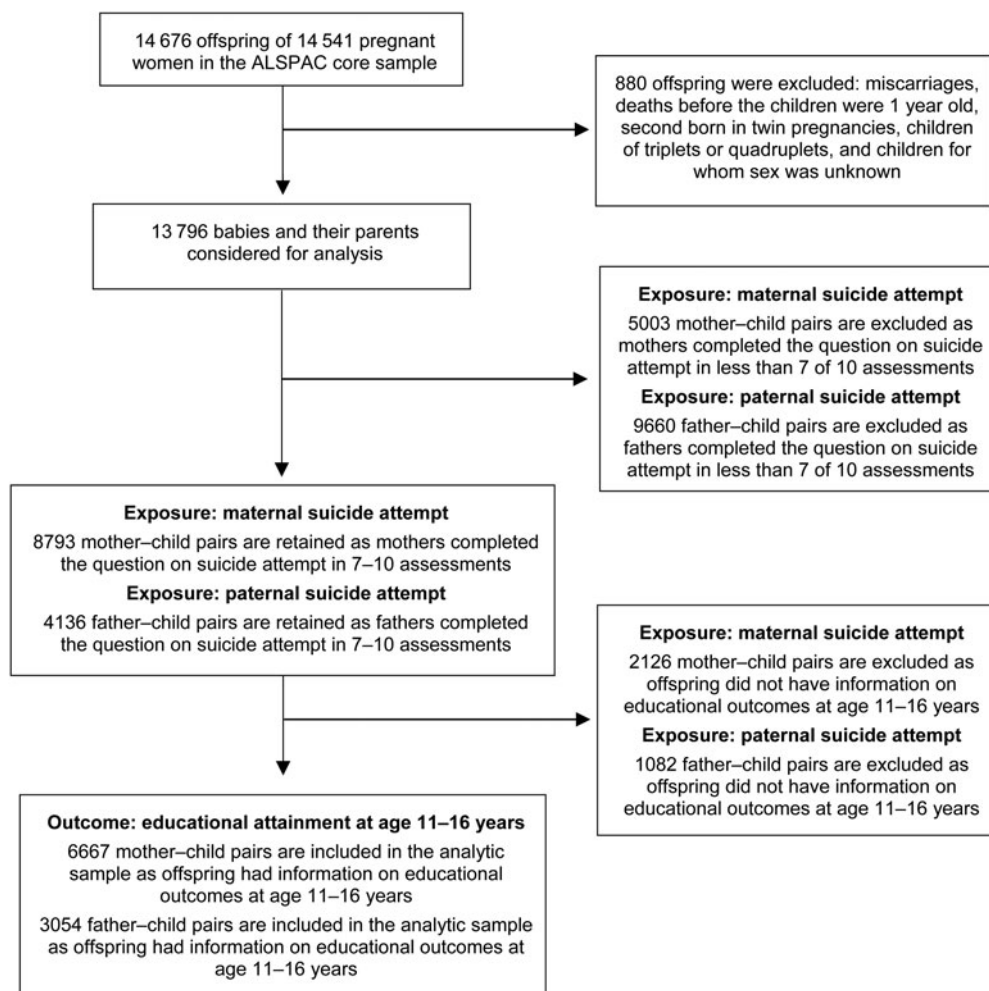


Fig. 1. Flow diagram of the sample selection process. ALSPAC, Avon Longitudinal Study of Parents and Children.

classified as 'suicide attempters', or otherwise, as a 'non-suicide attempter'.

We used information on ALSPAC participants' school performance in adolescence (age 11–16 years) as measured by the KS3 and KS4 national assessment exercises obtained through record linkage. The curriculum followed by English state schools is divided into a series of Key stages for different age groups and with expected levels of attainment at the end of each stage. KS3 normally covers ages 11–14 years while KS4 normally covers ages 14–16 years.

KS3

English, Mathematics and Science are the three core subjects at KS3. Attainment levels range between 1 and 7, with 1 being the lowest. To meet the national education requirement for KS3, pupils are expected to achieve level 5 or above in each of these subjects (Department of Education, 2005). We used one binary

outcome measure indicating whether or not the pupil achieved level 5 or above in all three subjects.

KS4

Pupils at the end of KS4 are normally entered for a range of General Certificate of Secondary Education (GCSE) examinations which are the qualifications taken by the vast majority of pupils at this stage. A small proportion of pupils take work-oriented alternative tests; these being allocated a GCSE-equivalent score in the data provided to us.

Key stage qualifications are graded on a standard eight-point scoring system of A* to G. It is set as a standard that students should obtain a minimum of five qualifications at the end of KS4 at a grade A*–C (Rothon *et al.* 2009). In this paper, we used two binary KS4 indicators of academic success: (1) achieving the expected standard, i.e. five or more qualifications at grade A*–C; (2) excelling (obtaining five or more qualifications at grade A* or A).

Possible confounders

Parental marital status (during pregnancy), socio-economic position (as indexed by maternal and paternal educational level as reported at 32 weeks of gestation), parental symptoms of depression, child ethnicity, child sex and their age at completing the respective Key stage were considered as potential confounders.

Parental educational level was grouped according to the highest reported qualification, based on the scheme in use when the parents were at school: (i) CSE (certificate of secondary education – qualifications of a lower level than O-levels generally obtained at age 16 years)/none; (ii) vocational or O-level (subject-specific qualifications generally obtained at age 16 years); and (iii) A-level (subject-specific qualifications generally obtained at age 18 years and required for university entry)/university degree in England.

Parental depression was measured at 18 weeks of gestation using the Edinburgh Postnatal Depression Scale (EPDS) – a widely used 10-item self-report screening scale for postpartum depression. Respondents rate how they felt in the preceding week; questions are scored on a 0–3 scale, with the total score ranging from 0 to 30 (Gibson *et al.* 2009).

Effect moderators

To examine the effect of timing of exposure to parental SA, we divided the group into children exposed before their 5th birthday and those exposed at 5–11 years. The timing of the child's exposure was derived from the parent-completed questionnaires.

Ethical approval

Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committees. Written informed consent had been obtained from all parents in the study. Further consent to use the educational data was obtained from the children once they had reached adolescence.

Statistical analysis

To assess the impact of parental SA on offspring educational performance, we used random-effects logistic regression models to account for clustering by school (ALSPAC participants were recruited from a single geographical area and so many attended the same schools in adolescence).

In all crude models we included the age of the child (in weeks) at completing the respective test and their sex as a covariate to account for the tendency for better performance from older children in a school year and the tendency of girls to outperform boys. Full adjusted

analyses additionally included the covariates ethnicity, parental marital status during pregnancy, socio-economic position (measured by maternal or paternal education attainment) and parental symptoms of depression at 18 weeks of gestation.

To assess the potential contribution of later measures of parental depression, we carried out further analysis on a subset of mother–child pairs (for whom measures of maternal depression at 33 months and 61 months postnatally were available). Of 6035 mother–child pairs, 5432 (90%) had information on maternal depression when the study child was 33 and 61 months.

To assess whether the associations varied by offspring sex or offspring age at exposure to parental SA, we tested, using a likelihood ratio (LR) test, whether accommodating such interactions improved the fit of models. By including both exposure to paternal and maternal SA in the same model we tested the null hypothesis of equal effects (i.e. equal coefficients in the population) using a Wald test.

We ran sensitivity analyses to examine the effect of alternative exclusion criteria for parents: (i) including only parents who completed all 10 assessments on SA; and (ii) including parents who completed three or more assessments of SA.

The analytic sample comprised of offspring who had data on academic performance at both KS3 (14 years) and KS4 (16 years). This meant we excluded privately educated children because private schools do not take part in KS3 testing. We ran sensitivity analysis to assess the effect of including these children in our analysis of the associations with KS4 tests.

Stata version 13.0 was used for all analyses (StataCorp, 2013).

Results

Compared with ALSPAC participants who were excluded due to missing data, parents in the present study sample were older and more likely to be married. The mothers in the study sample were more likely to have intermediate-level occupations and education. Mean EPDS score (depressive symptoms) was lower in study parents and whilst there was no difference in the prevalence of SA in mothers, in fathers the prevalence of SA was higher in the study sample compared with the rest of the cohort (Table 1).

The majority of children (74%) obtained level 5 or above in all three subjects (English, Maths or Science) at the end of KS3 (Table 2). Of the children, 73% obtained grade A*–C in at least five KS4 qualifications. Only 17% achieved grade A* or A in five or more qualifications. The proportion of achievers was lower in offspring exposed to parental SA than in their

Table 1. Characteristics of Avon Longitudinal Study of Children and Parents participants included and those excluded from this study (n = 13 796)

Characteristics	Data available in sample/ excluded ^a	Study sample	Excluded from this study	<i>p</i>
Mothers, <i>n</i>		6667	7129	
Mother's age at conception, years: mean (s.d.)	6667/7127	27.8 (4.6)	26.6 (5.3)	<0.0001
Maternal marital status at study entry, % married ^a	6573/6349	80.2	69.5	<0.0001
Maternal education, %				
≥ A level	6527/5732	35.6	35.1	<0.0001
O level		38.3	30.4	
<O level		26.1	34.6	
Maternal social class, %				
Non-manual	5534/4396	35.9	39.1	<0.0001
Intermediate		52.8	47.9	
Manual		11.3	13.0	
Maternal symptoms of depression (EPDS): mean (s.d.)	6204/5615	6.7 (4.6)	7.3 (5.1)	<0.0001
Maternal suicide attempt, %	6667/2126	1.9	1.9	1.0
Fathers, <i>n</i>		3054	10 742	
Father's age at 12 weeks of gestation, years: mean (s.d.)	2761/5295	31.4 (5.3)	30.2 (5.9)	<0.0001
Paternal marital status at study entry, % married	2860/5540	89.2	78.1	<0.0001
Paternal education, %				
≥ A level	2981/8802	52.7	41.3	<0.0001
O level		24.2	20.2	
<O level		23.1	38.5	
Paternal suicide attempt, %	3054/1153	1.0	0.4	0.07
Paternal symptoms of depression (EPDS): mean (s.d.)	2928/6658	3.8 (3.7)	4.4 (4.0)	<0.0001
Offspring, <i>n</i> ^b		6667	7129	
Offspring sex, % females	6667/7129	49.5	47.4	0.01
Offspring ethnic origin, % white ^c	6660/6801	96.6	92.7	<0.0001

s.d., Standard deviation; EPDS, Edinburgh Postnatal Depression Scale.

^a The *n* contributing to each comparison; the *n* in each comparison is based on the availability of data on the variable of interest; the sum of included and excluded may differ from the total *n* = 13 796.

^b The sample in this comparison is based on mother-offspring pairs.

^c Children whose mother and father are white.

unexposed peers and greater in girls relative to boys across the academic parameters assessed (results not shown).

Maternal SA

The likelihood of achieving level 5 or above in all three subjects at age 14 years was markedly lower in study members whose mothers had attempted suicide than in those whose mothers had not attempted suicide [odds ratio (OR) 0.49, 95% confidence interval (CI) 0.33–0.71], even after controlling for all potential confounders [adjusted OR (aOR) 0.63, 95% CI 0.41–0.95] (Table 3).

Adjusting for sociodemographic variables including maternal educational attainment, offspring whose mothers had attempted suicide were less likely to obtain five or more KS4 qualifications at the expected grade A*–C (aOR 0.66, 95% CI 0.43–1.00) and less likely to achieve five or more KS4 qualification at grade A* or A (aOR 0.39, 95% CI 0.16–0.95) compared with their unexposed peers. However, further adjustment for maternal symptoms of depression weakened these associations and the results no longer reached conventional levels of statistical significance (aOR 0.74, 95% CI 0.48–1.13; aOR 0.42, 95% CI 0.18–1.04, respectively). There was no evidence that the associations of maternal SA with offspring educational achievement differed in males and females (*p* for

Table 2. Offspring attaining a specified indicator of academic level by exposure to maternal and paternal suicide attempt

	Total <i>n</i>	Age 14 years	Age 16 years	
		Level 5+ in English, Maths and Science	5+ qualifications at grade A*–C	5+ qualifications at grade A* or A
Mother–offspring pairs	6667	4915 (74)	4874 (73)	1151 (17)
Exposed to maternal suicide attempt	126	71 (56)	75 (60)	6 (5)
Not exposed to maternal suicide attempt	6541	4844 (74)	4799 (73)	1145 (18)
Father–offspring pairs	3054	2436 (80)	2435 (80)	712 (23)
Exposed to paternal suicide attempt	31	20 (65)	20 (65)	4 (13)
Not exposed to paternal suicide attempt	3023	2416 (80)	2415 (80)	708 (23)

Data are given as number (percentage).

Table 3. Association of maternal and paternal suicide attempt with their offspring's educational attainment in adolescence

Indicators of educational performance	Model 1 ^a	Model 2 ^{a,b}	Model 3 ^{a,b,c}	Model 4 ^{a,b,c,d}
Mother–offspring pairs, <i>n</i>	6667	6035	6035	6035
Key stage 3 (age 14 years)				
Achieved level 5 or above in English, Maths and Science	0.49 (0.33–0.71)	0.45 (0.30–0.68)	0.54 (0.36–0.83)	0.63 (0.41–0.95)
Key stage 4 (age 16 years)				
Achieved five or more qualifications at grade A*–C	0.62 (0.42–0.91)	0.53 (0.35–0.80)	0.66 (0.43–1.00)	0.74 (0.48–1.13)
Achieved five or more qualifications at grade A* or A	0.27 (0.11–0.66)	0.28 (0.12–0.69)	0.39 (0.16–0.95)	0.42 (0.18–1.04)
Father–offspring pairs, <i>n</i>	3054	2716	2716	2716
Key stage 3 (age 14 years)				
Achieved level 5 or above in English, Maths and Science	0.52 (0.23–1.15)	0.51 (0.22–1.23)	0.60 (0.24–1.48)	0.65 (0.26–1.62)
Key stage 4 (age 16 years)				
Achieved five or more qualifications at grade A*–C	0.46 (0.21–0.99)	0.41 (0.18–0.94)	0.46 (0.20–1.08)	0.46 (0.20–1.08)
Achieved five or more qualifications at grade A* or A	0.51 (0.16–1.61)	0.57 (0.18–1.82)	0.58 (0.18–1.90)	0.60 (0.18–1.98)

Data are given as odds ratio (95% confidence interval) unless otherwise indicated.

^a Adjusted for offspring sex and age (in weeks) at test completion.

^b Based on subset with data on all confounding factors.

^c Adjusted for sociodemographic variables: maternal/paternal marital status, maternal/paternal educational attainment at 32 weeks of gestation, child ethnic origin.

^d Adjusted for maternal/paternal depression measured during pregnancy.

interaction = 0.15–0.51) although for all three educational outcomes the effect estimates were larger in girls than in boys. Similarly, there was no evidence of a differential association for offspring exposed in early childhood (<5 years) compared with later childhood (5–11 years) in term of educational performance (*p* for LR test of interaction = 0.32–0.96).

Paternal SA

Participants whose fathers had attempted suicide were less likely to obtain level 5 or above in English, Maths and Science by 14 years relative to their unexposed peers but the results of the unadjusted model were consistent with chance (Table 3). There was evidence

Table 4. Association of maternal and paternal suicide attempt with offspring educational attainment using two alternative selection criteria for including parents in the analytic sample^a

Offspring outcomes	Number of assessments on suicide attempt completed by the parent		
	7–10	3–10	All 10
Number in sample (<i>n</i> exposed to maternal suicide attempt)	6667 (126)	8826 (176)	3519 (51)
Key stage 3 (age 14 years)			
Achieved level 5 or above in all three subjects	0.49 (0.33–0.71)	0.50 (0.36–0.70)	0.46 (0.25–0.86)
Key stage 4 qualifications (age 16 years)			
Achieved five or more qualifications at grade A*–C	0.62 (0.42–0.91)	0.63 (0.46–0.88)	0.62 (0.33–1.17)
Achieved five or more qualifications at grade A* or A	0.27 (0.11–0.66)	0.30 (0.14–0.63)	0.42 (0.16–1.12)
Number in sample (<i>n</i> exposed to paternal suicide attempt)	3054 (31)	5861 (55)	1020 (5)
Key stage 3 (age 14 years)			
Achieved level 5 or above in all three subjects	0.52 (0.23–1.15)	0.44 (0.24–0.78)	0.23 (0.04–1.53)
Key stage 4 qualifications (age 16 years)			
Achieved five or more qualifications at grade A*–C	0.46 (0.21–0.99)	0.36 (0.21–0.64)	0.21 (0.03–1.36)
Achieved five or more qualifications at grade A* or A	0.51 (0.16–1.61)	0.48 (0.18–1.32)	1.32 (0.18–9.63)

Data are given as crude odds ratio (95% confidence interval) unless otherwise indicated.

^a The models are adjusted for the offspring sex and their age (in weeks) at the time of assessment.

that offspring whose father had attempted suicide were less likely to obtain five or more KS4 qualifications at the standard grade (A*–C) compared with the unexposed (OR 0.46, 95% CI 0.21–0.99) but adjustment for relevant confounders attenuated the association such that it was consistent with chance (aOR 0.46, 95% CI 0.20–1.08). Participants exposed to paternal SA were also less likely to obtain at least five KS4 qualifications at a top grade (A* or A) but these results too may have occurred by chance (aOR 0.60, 95% CI 0.18–1.98).

There was no evidence that the impact of paternal SA was related to offspring educational attainment differently in boys and girls (*p* for interaction = 0.75–0.86) or that the impact of paternal SA was different for children exposed at a younger (<5 years) or older (5–11 years) age (*p* for LR test of interaction = 0.37–0.61).

The impact of maternal compared to paternal SA

The effect of maternal and paternal SA was similar across offspring outcomes (*p* = 0.30–0.90). However, this analysis is based on a relatively small subset of families in which both mothers and fathers completed seven or more assessments about SA (*n* = 3054).

Sensitivity analysis

We examined the effect of controlling for later measures of parental depression in a subset of data where this information was available (*n* = 5432 mother–child pairs). The results showed that exposure to maternal SA was associated with poorer KS4

performance (OR 0.51, 95% CI 0.34–0.76). Adjustment for sociodemographic variables, including maternal education, attenuated this association (aOR 0.59, 95% CI 0.38–0.92) while further adjustment for maternal depression at 18 weeks of gestation markedly attenuated the association (aOR 0.68, 95% CI 0.44–1.07). Subsequent adjustment for maternal depression at 33 months after birth further weakened the association (aOR 0.73, 95% CI 0.47–1.14) but controlling for a third measure of maternal depression (at 61 months postpartum) had very little effect on estimates (aOR 0.74, 95% CI 0.47–1.15). Exposure to maternal SA was also associated with offspring's likelihood of excelling (i.e. obtaining five or more qualifications at grade A* or A) at age 16 years in a model adjusting for sociodemographic variables and maternal depression during pregnancy (aOR 0.38, 95% CI 0.15–0.98). Adjustment for further measures of maternal depression measured when the children were 33 months and 61 months had no effect on estimates (aOR 0.38, 95% CI 0.14–0.98; aOR 0.37, 95% CI 0.15–0.97, respectively).

Table 4 summarizes the crude effect estimates of the association of parental SA with offspring outcomes using two alternative criteria: (1) a complete-case analysis; (2) all parents who completed 3–10 assessments on SA and their children (a more representative sample of the ALSPAC population). Despite some variability across the different inclusion criteria, the findings are generally consistent with the primary analysis.

Privately educated pupils (comprising approximately 6% of ALSPAC participants) were not included in

the primary analysis sample. Including these pupils in a sensitivity analysis of KS4 attainment, the analysis showed that the likelihood of obtaining five qualifications or more at grade A*–C by age 16 years was lower among offspring whose mother (aOR 0.73, 95% CI 0.48–1.12) or father (aOR 0.46, 95% CI 0.20–1.07) had attempted suicide relative to unexposed offspring. These results were broadly consistent with findings from the primary analysis.

Discussion

There was strong evidence that adolescents whose mother had attempted suicide performed less well than unexposed adolescents in their Key stage tests at age 14 years. Adolescents whose mother had attempted suicide were also less likely to achieve the expected standard at age 16 years (Department of Education, 2010) and less likely to excel, but the associations between maternal SA and offspring educational attainment at age 16 years were consistent with chance after adjustment for maternal depression. Findings were similar in relation to SA by fathers but the smaller sample size meant that statistical evidence for the associations was weak.

Parental educational attainment is a strong predictor of offspring educational attainment (Dubow *et al.* 2009) and is associated with SA (Burrows & Laflamme, 2010). Similarly, parental depression has been linked to their offspring's academic success (Murray *et al.* 2010) and is strongly associated with their own risk of SA (Bolton *et al.* 2008). In our study it could be that parental educational attainment or depression or both influenced both their own risk of SA and their child's educational achievement although controlling for both these factors only partially attenuated the associations we observed.

The findings from the present study are generally consistent with findings from earlier studies showing that parental suicidal behaviour is associated with long-term adverse effect on their offspring's mental health (Geulayov *et al.* 2012). Furthermore, a small body of research evidence shows that exposure to parental psychopathology is associated with adverse developmental and academic outcomes. Maternal postnatal depression is associated with a small negative effect on offspring cognitive development in young children (Grace *et al.* 2003) and adolescence (Hay *et al.* 2001, 2008; Murray *et al.* 2010), although effects are apparent mainly in boys. However, findings from a large study based on the ALSPAC cohort showed no effect of maternal postnatal depression on offspring cognitive performance at 16 years (Evans *et al.* 2012). Similarly, studies found that parental death (including death due to suicide) in childhood

or adolescence was associated with poorer educational outcomes (Brent *et al.* 2012; Berg *et al.* 2014).

Previous research has demonstrated a difference in the impact of parental suicidal behaviour on suicidal behaviour in sons and daughters although studies produced mixed results, some showing greater risk of adverse outcomes in daughters (Sorensen *et al.* 2009; Gravseth *et al.* 2010) while others demonstrating greater risk in sons (Goodwin *et al.* 2004; Mittendorfer-Rutz *et al.* 2008). Our results for education are consistent with two earlier studies (Mittendorfer-Rutz *et al.* 2008; Garssen *et al.* 2011) which reported similar risk of suicidal behaviour in sons and daughters.

Very few studies have addressed the effect of offspring age at exposure to parental suicidal behaviour on offspring outcome. One large study reported that exposure to parental death by suicide before 18 years was associated with increased likelihood of death by suicide compared with exposure at or after 18 years although the risk of SA and depression was not elevated in offspring exposed earlier rather than later (Wilcox *et al.* 2010). This finding is consistent with evidence from studies on the impact of parental loss demonstrating that early exposure to adversity may be associated with greater risk of psychopathology (Agid *et al.* 1999; Mortensen *et al.* 2003). In a recent study, Kuramoto *et al.* (2013) showed that exposure to parental suicide in early childhood (age 0–5 years) rendered these children more vulnerable to hospitalization for SA relative to children exposed at older age. Using similar age groups, our study did not demonstrate differences in academic success in offspring exposed before 5 years or between 5 and 11 years. It could be that our analysis was underpowered to detect such differences or that timing of exposure has different implications for different outcomes since pathways of transmission may differ. More data are required to explore whether timing of exposure is related to the differences in vulnerability to offspring outcomes as such findings may have important implications for interventions.

Parental SA may be linked to educational attainment in adolescence because parental SA is associated with greater risk of psychopathology and emotional difficulties in their offspring and psychopathology is associated with diminished academic success (Kessler *et al.* 1995). Parental SA may also be associated with low parental involvement and responsiveness, as parents who attempt suicide may be subject to distracting circumstances and have little time to support their child and this may influence the child's cognitive development, school attendance, as well as the development of academic skills. Evidence suggests that parental involvement is predictive of their child academic performance (Shute *et al.* 2011). Parental SA may be a traumatic and stressful event which interferes with the child's routine and

consequently can lead to lower achievement (Streeck-Fischer & van der Kolk, 2000). Evidence shows that memory and concentration are adversely affected by traumatic events (Streeck-Fischer & van der Kolk, 2000). Alternatively, parental SA may lead to direct adverse effect on the child's environment, e.g. separation, change of living conditions, change in employment and income all may interfere with the child's ability to achieve academic goals and parent's ability to support this. Parents who attempt suicide might also transmit some genetic vulnerability to mental health or behavioural problems and these may influence cognitive development and academic performance but no studies have tested these hypotheses.

The main strengths of this study are the repeatedly recorded data on parental SA and the objective measure of offspring educational attainment in a large well-studied prospective cohort followed up since birth. Information on parental SA was collected directly and repeatedly from parents, minimizing potential recall bias. Furthermore, the measures used to assess educational attainment are objective and standardized and at age 16 years include both academic and vocational educational pathways and as such are relevant to practically all children in the cohort.

However, the study has several limitations. First, in the ALSPAC cohort, it was the mothers who were recruited into the study. As the questionnaires for the fathers were sent through the mothers (Golding *et al.* 2001), the data on fathers are less complete. Second, we restricted the analysis to parents (and their children) who provided 70% or more of the information on SA across 10 assessments. Using this conservative approach resulted in a selective sample of healthier and more socio-economically advantaged families. We carried out a series of sensitivity analyses to assess the effect of using alternative inclusion criteria (see Method and Results sections). The results generally demonstrated that the findings were consistent across samples resulting from applying alternative inclusion criteria, a finding consistent with our previous work (Geulayov *et al.* 2014). Third, we may not have fully controlled for the possible confounding effect of parental education and mental health; we only have information on the highest-level tests taken by parents, rather than their actual examination performance and we only controlled for a measure of depression recorded at one point in the parents' lives. However, we examined the effect of controlling for later measures of parental depression in a subset of data where this information was available. There was no clear and consistent effect of further adjustment for maternal depression measured later in their child's life on the strength of association between parental attempted suicide and offspring school performance.

While the inclusion of further measures of depression in the models weakened the association with offspring school performance at age 14 years it had no impact on the strength of association at age 16 years. Furthermore, the interpretation of controlling for parental depression occurring after the parent has attempted suicide is not straightforward. Finally, since exposure to parental SA is rare, our analysis may have limited power to detect an association.

Our findings suggest that it is important to address the impact of parental SA on multiple aspects of offspring well-being by both research and intervention strategies. To date, research has focused on offspring psychopathology in relation to suicidal behaviour in their parents. Our findings of an association between parental SA and offspring's school success may have implications for their future life opportunities and well-being. Furthermore, interventions designed for offspring of parents with a history of suicidal behaviours have focused exclusively on parental death by suicide. There is accumulating evidence that exposure to parental SA is associated with negative outcomes in multiple areas of functioning. The needs of children and families exposed to parental SA may be qualitatively different from families coping with parental death by suicide. Nevertheless, it is important to replicate these findings and examine potential pathways which can account for the observed association to aid the development of potentially effective preventative measures. Treatment services for individuals who attempt suicide may need to consider their children's needs assessing, among other issues, potential academic difficulties and identifying ways in which these children's needs can be met.

In conclusion, offspring whose mother had attempted suicide were more likely to fall short of the expected level of educational attainment at age 14 years relative to their unexposed peers but the evidence in relation to their chance of educational achievement at age 16 years was weak after accounting for maternal depression. There was no convincing evidence that the strength of association varied by parental sex, offspring sex, or child's age at exposure. The results emphasize the need to address the impact of parental SA on multiple aspects of offspring well-being by both research and intervention strategies. Furthermore, treatment services for individuals who attempt suicide may need to consider their children's needs including potential academic difficulties and identify ways in which they can be helped.

Acknowledgements

We are extremely grateful to all the 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 scientists, volunteers, managers, receptionists and nurses. We would like to thank Ms Amy Davies and Dr Jon Heron (University of Bristol) for their help with the ALSPAC data and Dr Jon Heron for advising us on statistical analysis. The UK Medical Research Council and the Wellcome Trust (grant reference 102215/2/13/2) and the University of Bristol provide core support for ALSPAC.

Declaration of Interest

The work of G.G. was funded by the University of Bristol Overseas Postgraduate Research Scholarship. D.G. is a National Institute for Health Research Senior Investigator. C.M. reports no biomedical financial interests or potential conflicts of interest.

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