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REVIEW ARTICLE

The association of parental fatal and non-fatal suicidal behaviour with offspring suicidal behaviour and depression: a systematic review and meta-analysis

G. Geulayov[1]*, D. Gunnell[1], T. L. Holmen[2] and C. Metcalfe[1]

[1] *School of Social and Community Medicine, University of Bristol, Bristol, UK*
[2] *Department of Public Health and General Practice, Norway University of Science and Technology, Trondheim, Norway*

Background. Children whose parents die by, or attempt, suicide are believed to be at greater risk of suicidal behaviours and affective disorders. We systematically reviewed the literature on these associations and, using meta-analysis, estimated the strength of associations as well as investigated potential effect modifiers (parental and offspring gender, offspring age).

Method. We comprehensively searched the literature (Medline, PsycINFO, EMBASE, Web of Science), finding 28 articles that met our inclusion criteria, 14 of which contributed to the meta-analysis. Crude odds ratio and adjusted odds ratio (aOR) were pooled using fixed-effects models.

Results. Controlling for relevant confounders, offspring whose parents died by suicide were more likely than offspring of two living parents to die by suicide [aOR 1.94, 95% confidence interval (CI) 1.54–2.45] but there were heterogeneous findings in the two studies investigating the impact on offspring suicide attempt (aOR 1.31, 95% CI 0.73–2.35). Children whose parents attempted suicide were at increased risk of attempted suicide (aOR 1.95, 95% CI 1.48–2.57). Limited evidence indicated that exposure to parental death by suicide is associated with subsequent risk of affective disorders. Maternal suicidal behaviour and younger age at exposure were associated with larger effect estimates but there was no evidence that the association differed in sons *versus* daughters.

Conclusions. Parental suicidal behaviour is associated with increased risk of offspring suicidal behaviour. Findings suggest that maternal suicidal behaviour is a more potent risk factor than paternal, and that children are more vulnerable than adolescents and adults. However, there is no evidence of a stronger association in either male or female offspring.

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Key words: Meta-analysis, offspring depression, offspring suicidal behaviour, parental suicidal behaviour, systematic review.

Introduction

Each year about one million people die by suicide worldwide. Moreover, for each completed suicide approximately 30 individuals attempt suicide. It has been estimated that for every suicide six people suffer intense grief so that about six million people are bereaved each year through suicide (Clark & Goldney, 2000), but no precise data on the proportion of children who lose a parent through suicide are available. Pfeffer (2000) estimated that in the USA alone 10 000 to 20 000 children and adolescents are bereaved by suicide each year. Many more, however, are exposed to non-fatal suicidal acts by their parents.

It is widely believed that offspring exposed to parental suicidal behaviour are at risk of a variety of problems, including suicidal behaviours, affective disorders, high-risk behaviours, and impaired social and academic functioning. In a narrative review of the literature published up until 2008, Hung & Rabin (2009) found modest evidence that parental suicide increased the risk of depression, anxiety, bipolar disorder and suicidal behaviour, but studies failed to reveal consistent differences between offspring bereaved by parental suicide and those bereaved by other causes. In a review of nine studies Kuramato *et al*. (2009) concluded that the existing evidence provides modest

* Address for correspondence: G. Geulayov, M.Sc., School of Social and Community Medicine, University of Bristol, Canynge Hall, 39 Whatley Road, Bristol BS8 2PS, UK.
(Email: Galit.Geulayov@bristol.ac.uk)

yet inconsistent evidence on the impact of parental suicide on offspring psychiatric and psychosocial outcomes. Neither of these reviews included a formal meta-analysis, which would allow evidence from the individual studies to be brought together to give precise estimates of the strength of associations, and would allow, given a large enough number of studies, investigation of effect modifiers such as age at exposure to parental suicidal behaviour. Furthermore, since these reviews were published, the literature in this area has expanded considerably.

The aim of the present review is to summarize research findings from studies of the association of parental fatal and non-fatal suicidal behaviour with offspring suicidal behaviour and depression. Furthermore, we investigate possible causes of heterogeneity in study findings, and whether there is evidence that the association differs according to the gender of the self-harming parent, offspring gender and offspring age at parental suicidal behaviour.

Method

Search strategy

We conducted a comprehensive search of all published literature on the association of parental (fatal and non-fatal) suicidal behaviour with offspring suicidal behaviour and/or depression. The search strategy included Medline OvidSP (1950–April 2011), PsycINFO (1876–April 2011) and EMBASE (1980–April 2011) using both medical subject heading (MeSH) and text word searches.

For the MeSH search, we combined the terms (parents *or* mothers *or* fathers *or* caregivers *or* paternal behavior *or* maternal behavior *or* family) *AND* (suicide *or* suicide, attempted *or* suicidal ideation, *or* self-mutilation *or* self-injurious behavior *or* overdose *or* depression or depressive disorder or depressive disorder, major *or* psychopathology) *AND* (child *or* adolescent *or* young adults).

Text word search: ((Parent$ *or* mother$ *or* father$ *or* caregiv$ *or* paternal$ *or* maternal$ *or* famil$) *adj2* (suicid$ *or* parasuicid$ *or* attempt$ suicid$ *or* suicid$ ideation *or* suicid$ thought$ *or* suicid$ behavio?r$ *or* suicid$ intent$ *or* suicid$ gestur$ *or* suicid$ act$ *or* suicid$ tendenc$ *or* self?harm$ *or* self?mutilat$ *or* self?poison$ *or* self injur$ behavio?r$ *or* overdos$ *or* self?injur$)).af.

To exclude papers on assisted suicide, a search for 'assisted suicide' and 'euthanasia' using the MeSH was carried out.

A Web of Science citation search used 11 key studies (Cain & Fast, 1966; Shepherd & Barraclough, 1976; Pfeffer, 1981; Roy, 1983; Egeland & Sussex, 1985; Papadimitriou *et al*. 1991; Pfeffer *et al*. 1994, 1998; Grossman *et al*. 1995; Cerel *et al*. 1999, 2000) identified through the search strategy above. These studies included both the earliest publications in this field as well as those that have been most widely cited in the literature. We hand searched the reference lists of key review and research papers identified in this review.

The search was repeated on a weekly basis (using 'auto alert option') until April 2011. After removing duplicates we were left with 6855 publications. Titles and abstracts were assessed using the inclusion criteria specified below. When abstracts were not available or if after reading the titles and abstracts a decision could not be made, we obtained the full paper to assess eligibility.

Inclusion and exclusion criteria

Fig. 1 depicts the paper selection process. We included studies in which a parent (biological or non-biological) had died by suicide or attempted suicide and in which outcomes in their offspring included suicidal behaviour (fatal or non-fatal) and/or depression. We did not apply language restrictions.

We excluded: studies which did not include at least one of the two outcomes of interest (depression or suicidal behaviour); studies that measured outcomes in individuals who were exposed to suicidal behaviour of a family member but where no clear distinction between parents and other family members was made; studies in which the group exposed to parental suicide was not analysed as a separate group, i.e. all offspring whose parents died were grouped and compared with offspring of living parents; case series and case reports.

Data extraction

Two investigators (G.G. and D.G. or C.M.) extracted data from each paper independently using a standardized data extraction form. Data were extracted on study design, sample source and recruitment method, definition of suicidal behaviour, age of offspring at parental suicidal behaviour, comparison groups, and follow-up time points. For the two outcomes of interest we extracted information on the measures used, source of information, unadjusted and adjusted results, and factors adjusted for. We also noted whether or not the study distinguished between exposure to paternal and maternal suicidal behaviour, compared exposure in female *versus* male offspring, whether investigators assessed the effect of offspring age at exposure to parental suicidal behaviour, and whether or not the analysis accommodated clustering of multiple

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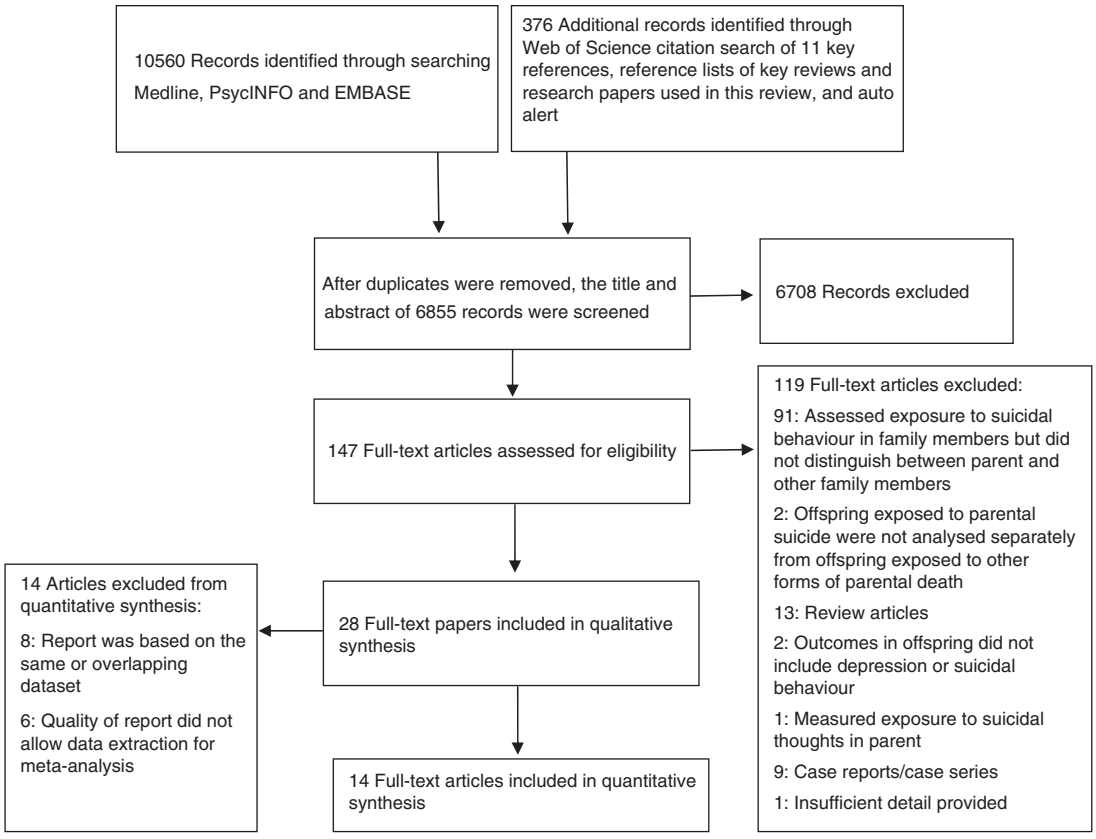

Fig. 1. Study selection process for systematic review and meta-analysis.

offspring from the same family. If more than one adjusted analysis was reported, we extracted the figure produced by adjustment for the larger number of factors.

Authors were contacted where data were missing or not clear, or where it was stated that an adjusted analysis had been carried out but no results were presented.

Statistical analysis

We undertook a meta-analysis of those studies with appropriate data. We extracted information on crude and adjusted effect sizes and confidence intervals (CIs), comparing the occurrence of suicidal behaviours and depression in offspring of parents who died by suicide or attempted suicide with that of a comparison group as reported by the authors. If these were not available, we calculated the crude odds ratio (OR) and CI after extracting the number of cases and non-cases in offspring exposed and unexposed to the factor of interest from each study.

When papers provided estimates of the risk ratio or hazard ratio, we used these as estimates of the OR. This was reasonable since the outcomes in this systematic review are rare, so that these different effect estimates are very similar in value.

If numbers were presented by exposure (i.e. mother and father) or by subgroups (i.e. daughters and sons), an overall estimate was obtained by pooling the effect estimate of the two groups. In the former case (i.e. when the effect of exposure to maternal and paternal suicidal behaviour were presented separately), a simple pooling of these estimates would 'double-count' individuals in the control group as they contribute to both estimates. In this case we 'halved' the control group (Higgins & Green, 2008) to avoid misleading indication of precision.

When two or more papers reported on the same sample they were included in the meta-analyses if they contributed to different meta-analyses. Otherwise, we included the results from the paper achieving the greatest precision as measured by the standard error of the estimate or the study with the fullest presentation of results relevant to the current analysis.

Crude OR may be adjusted for age and gender. The overall ORs were estimated using fixed-effects models; when significant heterogeneity was identified

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Table 1. *Characteristics of studies included in the systematic review grouped by study design*

First author	Year	Study location	Expo-sure	Sample source	Offspring sample, *n*	Age[a], years	Study group		Comparison group		Information source		Outcomes
							Exposure	*n*	Exposure	*n*	Parent	Offspring	
Cross-sectional													
Sorenson[b]	1991	USA	SA	PB	2304	18+	Parental suicide attempt	71	No parental suicide attempt	2233	DI-OR	DI-SR	SA
Brent	2002	USA	SA	CL	299	2+	Parental suicide attempt	183	No parental suicide attempt	116	DI-SR	DI-SR	SA, MD
Goodwin	2004	USA	SA	PB	8098	15–54	Parental suicide attempt	294	No parental suicide attempt	Not clear	Q-OR	Q-OR	SA
Case–control[c]													
Pfeffer	1994	USA	SA	CL	123	Pre- and young adolescence	Parental suicide attempt	53 Cases	No parental suicide attempt	70 Controls[d]	DI-SR	DI-SR	SA
Pfeffer[b]	1998	USA	SA	CL	133	Pre pubertal	Parental suicide attempt	69 Cases	No parental suicide attempt	64 Controls[d]	DI-SR	DI-SR	SA
Weller[b]	2001	USA	SB	CL	58	5–13	Parent suicidal behaviour	Not clear	No parent suicidal behaviour	Not clear	DI-OR	DI-SR	SA
Agerbo[e]	2002	Denmark	S	PB	25 296	10–21	Parental death by suicide	496 Cases[c]	Parental death by other cause Two living parents	24 800 Controls[c]	PR	PR	S
Qin[e]	2002	Denmark	S	PB	84 502	9–45	Parental death by suicide without psychiatric admission	4264 Cases[c]	No parental suicide, no psychiatric admission	80 238 Controls[c]	PR	PR	S
							Parental death by suicide with psychiatric admission		No parental suicide, psychiatric admission				
Kessing[e]	2004	Denmark	S	PB	32 765	Median 46 (quartiles 32–62)	Parental death by suicide	1565 Cases[c]	Parental death by other cause Two living parents	31 200 Controls[c]	PR	PR	BD
Tsuchiya[e]	2005	Denmark	S	PB	48 297	10+	Parental death by suicide	947 Cases[c]	Parental death by other cause Two living parents	47 350 Controls[c]	PR	PR	BD
Mittendorfer-Rutz[b,e]	2008	Sweden	S, SA	PB	158 840	10+	Parental death by suicide	14 440 Cases[c]	Parental death by other cause Two living parents	144 400 Controls[c]	PR	PR	SA
							Parental suicide attempt		No parental suicide attempt				
Christiansen[b,e]	2011	Denmark	S, SA	PB	72 765	10+	Parental death by suicide	3465 Cases[c]	Parental death by other cause Two living parents	69 300 Controls[c]	PR	PR	SA
							Parental suicide attempt		No parental suicide attempt				
Niederkrotenthaler[b,e]	2010	Sweden	S, SA	PB	About 220 000	10+	Parental death by suicide	1407 Suicides[c] 17 159 Suicide attempts[c]	Parental death by other cause Two living parents	About 200 000[c]	PR	PR	S, SA
							Parental suicide attempt		No parental suicide attempt				

Cohort studies												
Pfeffer	2000	USA	S	PB	80	5–13	Parental death by suicide	16	Parental death from cancer	64	Q-SR	Q-SR	D
Brent	2003	USA	SA	CL	393	10+	Parental suicide attempt	227	No parental suicide attempt	166	DI-SR, Q-SR	DI-SR, Q-SR	SA, MD
Christoffersen[b]	2003	Denmark	S, SA	PB	84 765	14–27	Parent suicidal behaviour	1646	No parent suicidal behaviour	83, 116	PR	PR	SA
Melhem	2008	USA	S	PB	394	7–25	Parental death by suicide	66	Parental death by accident	51	DI-SR, Q-SR	DI-SR, Q-SR	D
									Parental death by other cause	94			
									Two living parents	183			
Suvisaari[b]	2008	Finland	SA	CL	337	16+	Maternal suicide attempt	Not clear	No maternal suicide attempt	Not clear	PR	PR	S
Gravseth[b]	2010	Norway	S	PB	610 359	18.5+	Parental death by suicide	4480	No parental suicide	605 879	PR	PR	S
Sorensen[b]	2009	Denmark	S	PB	7177	Birth–36	Parental death by suicide	208	No parental suicide	6969	PR, Q-SR	PR, Q-SR	S
Burke[b]	2010	USA	S, SA	CL	337	10+	Parent suicidal behaviour	100	No parental suicidal behaviour	237	DI-SR	DI-SR	SA
Wilcox[b]	2010	Sweden	S	PB	About 700 000	Not clear	Parental death by suicide	44 397	Parental death by accident	41 467	PR	PR	S, SA, D
									Parental death by other cause	417 365			
									Two living parents	About 200 000			
Kuramoto[b]	2010	Sweden	S	PB	38 440	Not clear	Parental death by suicide	23 447	Parental death by accident	14 993	PR	PR	SA, D
Shepherd	1976	USA	S	PB	97	2–17	Parental death by suicide	36	Parental death by other cause	61	DI-SR	DI-OR	SA
Cerel	1999	USA	S	PB	358	5–17	Parental death by suicide	26	Parental death by other cause	332	DI-SR, Q-SR	DI-SR, Q-SR	D
Lieb	2005	Germany	SA	PB	933	14–17	Maternal suicide attempt	321	No maternal suicide attempt	612	DI-SR	DI-SR	SA
Melhem	2007	USA	SA	CL	365	Mean 20.2 (S.D. = 9.0)	Parental suicide attempt	205	No parental suicide attempt	160	DI-SR	DI-SR	SA
Brent[b]	2009	USA	S	PB	344	7–25	Parental death by suicide	53	Parental death by accident	44	DI-SR, Q-SR	DI-SR, Q-SR	D
									Parental sudden natural death	79			
									Two living parents	168			

SA, Suicide attempt; PB, population-based; DI-OR, diagnostic interview – reported by other family member; DI-SR, diagnostic interview – self-reported; CL, clinical; MD, mood disorder; Q-OR, questionnaire – reported by other family member; SB, suicidal behaviour – type is unspecified; S, suicide; PR, population register; BD, bipolar disorder; Q-SR, questionnaire – self-reported; D, depression; S.D., standard deviation.

[a] Age refers to the age of offspring at the time of participation in the study.

[b] Not included in previous review papers.

[c] A case–control design; number of participants in each group is stated according to outcome and not exposure.

[d] The sample was taken from a follow-up study (Pfeffer *et al.* 1991).

[e] Study design is nested case–control.

the random-effects estimate was also presented. Meta-analysis was performed using Stata version 11.2 (StataCorp LP, USA).

Results

Study characteristics

A total of 28 papers published between 1976 and 2011 met our inclusion criteria (Table 1). Of these, 14 had not been included in previous reviews (Sorenson & Rutter, 1991; Pfeffer *et al*. 1998; Weller *et al*. 2001; Christoffersen *et al*. 2003; Mittendorfer-Rutz *et al*. 2008; Suvisaari *et al*. 2008; Brent *et al*. 2009; Sorensen *et al*. 2009; Burke *et al*. 2010; Gravseth *et al*. 2010; Kuramoto *et al*. 2010; Niederkrotenthaler *et al*. 2010; Wilcox *et al*. 2010; Christiansen *et al*. 2011). Of these 28 papers, 14 were included in the meta-analysis (Agerbo *et al*. 2002; Brent *et al*. 2002; Christoffersen *et al*. 2003; Goodwin *et al*. 2004; Lieb *et al*. 2005; Tsuchiya *et al*. 2005; Melhem *et al*. 2008; Mittendorfer-Rutz *et al*. 2008; Suvisaari *et al*. 2008; Burke *et al*. 2010; Gravseth *et al*. 2010; Niederkrotenthaler *et al*. 2010; Wilcox *et al*. 2010; Christiansen *et al*. 2011), the remainder being excluded as they were based on the same or overlapping dataset (Pfeffer *et al*. 1994; Qin *et al*. 2002; Brent *et al*. 2003, 2009; Kessing *et al*. 2004; Melhem *et al*. 2007; Sorensen *et al*. 2009; Kuramoto *et al*. 2010) or the quality of report did not allow data extraction for meta-analysis (Shepherd & Barraclough, 1976; Sorenson & Rutter, 1991; Pfeffer *et al*. 1998, 2000; Cerel *et al*. 1999; Weller *et al*. 2001).

Of the 28 papers included in this review, three were cross-sectional, 10 were case–control, and 15 were cohort studies. Eight papers reported on samples recruited from clinical facilities while 20 were community-based studies. In 14 papers, investigators included a comparison group of offspring whose parents died by a cause other than suicide as well as a group with two living parents. Studies varied with respect to the factors controlled for in the analysis. Six studies contributing to eight meta-analyses controlled for parental psychiatric history, a well-established confounder, while three studies potentially over-adjusted by controlling for offspring psychiatric disorder.

Meta-analysis – offspring suicidal behaviour

We carried out meta-analyses investigating three forms of exposure (parental death by suicide, parental suicide attempt and parental suicidal behaviour, i.e. no distinction was made between suicide and suicide attempt), five outcome measures in offspring (suicide, suicide attempt, depressive disorder, bipolar disorder and mood disorder), two comparison groups (offspring with two living parents and offspring with one parent who had died from a cause other than suicide), crude and adjusted analyses.

Fig. 2 shows 12 forest plots for the association of parental suicidal behaviour and offspring suicidal behaviour. The meta-analysis showed that compared with offspring of two living parents, children who lost a parent to suicide were at a greater risk of dying by suicide (OR 2.32, 95% CI 1.99–2.70) and attempting suicide (OR 3.28, 95% CI 3.05–3.52). After adjustment for offspring age, gender, psychiatric disorder and parental psychopathology, the ORs for suicide (1.94, 95% CI 1.54–2.45) and suicide attempt (1.61, 95% CI 1.40–1.84) were somewhat attenuated. Due to considerable heterogeneity between the two studies reporting an adjusted association of parental suicide and offspring suicide attempt (I^2 84.1%, $p=0.012$) we re-ran the analysis using a random-effects model. As well as a wider CI, this estimated association was further attenuated [pooled adjusted OR (aOR) 1.31, 95% CI 0.73–2.35].

Furthermore, compared with offspring who lost a parent to a cause other than suicide, offspring of suicide decedents were at a greater risk of suicide (OR 1.81, 95% CI 1.56–2.10) and suicide attempt (OR 1.73, 95% CI 1.63–1.83). These studies did not adjust for confounders.

We also found that offspring whose parents attempted suicide were more likely to die by suicide (OR 3.40, 95% CI 2.82–4.10) and attempt suicide (OR 3.74, 95% CI 3.54–3.95) compared with offspring not exposed to parental suicide attempt. Excluding studies that did not present adjusted results (Brent *et al*. 2002; Suvisaari *et al*. 2008) did not change the pooled estimate (offspring suicide: OR 3.37, 95% CI 2.79–4.07; suicide attempt: OR 3.73, 95% CI 3.54–3.94). The aOR was 2.62 (95% CI 2.15–3.19) for offspring suicide and 2.06 (95% CI 1.92–2.21) for suicide attempt. We re-ran the latter analysis using a random-effects model due to heterogeneity (I^2 75.1%, $p=0.007$). There was no marked change in the pooled estimate (aOR 1.95, 95% CI 1.48–2.57).

Offspring depressive disorder

The pooled estimate from two studies (Melhem *et al*. 2008; Wilcox *et al*. 2010) showed that offspring who lost a parent to suicide had elevated risk (OR 3.01, 95% CI 2.81–3.23) for subsequent depression compared with offspring of two living parents. Only one of these studies presented adjusted effect (Wilcox *et al*. 2010); compared with a crude 3-fold increase in risk of depression (OR 3.0, 95% CI 2.80–3.22), the association diminished to 1.90 (95% CI 1.60–2.20) after the

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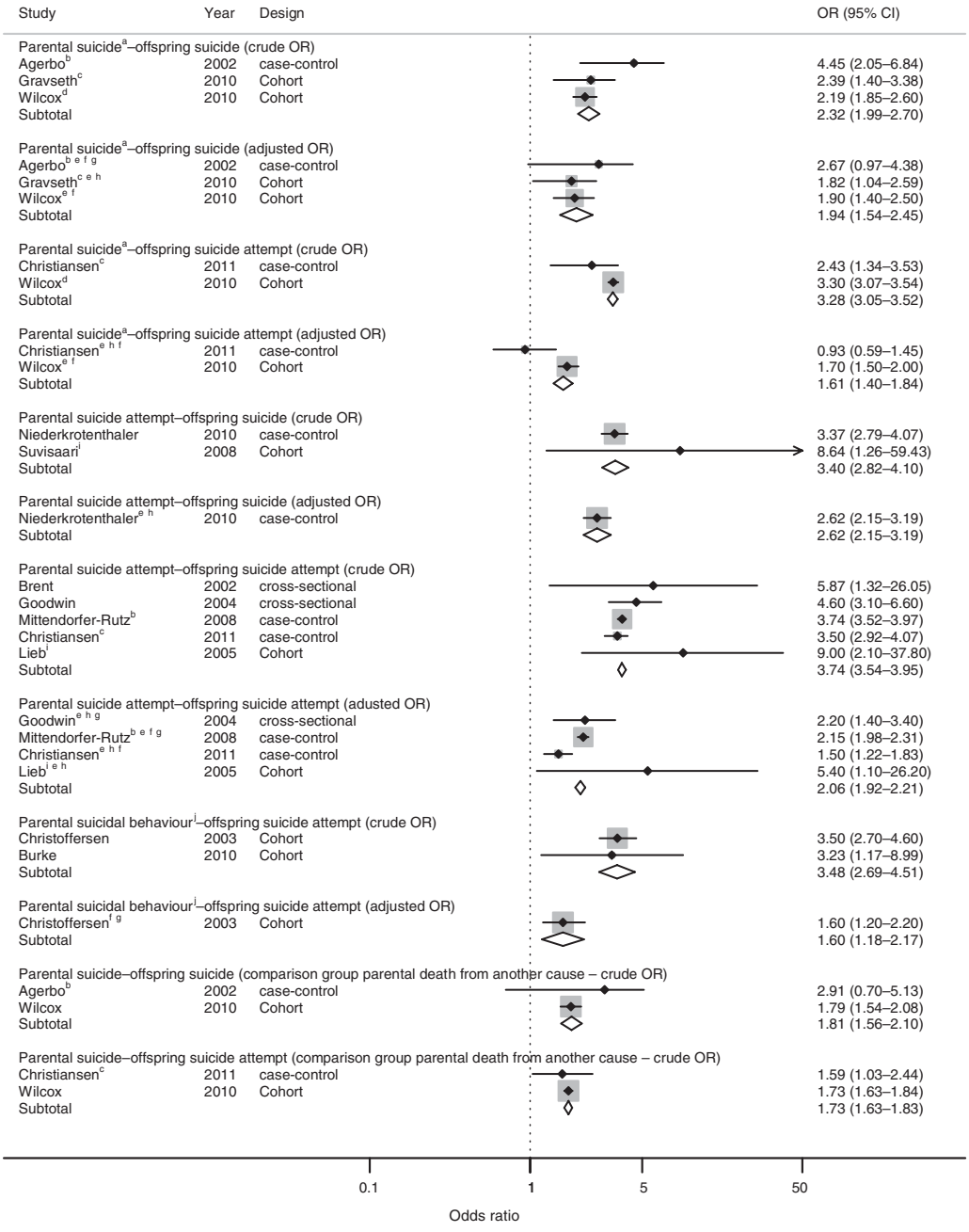

Fig. 2. Forest plot of the association of parental suicidal behaviour and offspring suicidal behaviour grouped by form of exposure and outcome. The overall odds ratio (OR) is calculated using the fixed-effects method. CI, Confidence interval. [a] Comparison group is offspring with two living parents. [b] Overall point estimate is calculated by pooling the effect size of maternal and paternal estimates. [c] Overall point estimate is calculated by pooling the effect size of female and male subgroups. [d] Matching could not be accommodated in the calculation of crude OR. [e] Study is adjusted for offspring age and gender. [f] Study is adjusted for parental history of psychiatric disorder. [g]Study is adjusted for offspring psychiatric disorder. [h] Study is adjusted for parental sociodemographic factors. [i] Studies report on exposure to maternal suicidal behaviour only. [j] Exposures to parental suicide and suicide attempt are analysed as a single group.

analysis was adjusted for psychiatric hospitalization and criminal convictions of the parents. However, compared with offspring of parents who died by other causes, the risk of depression was only slightly elevated for offspring of suicide decedents (OR 1.28, 95% CI 1.21–1.35) (Melhem *et al*. 2008; Wilcox *et al*. 2010); no adjusted analyses were available. A single study (Tsuchiya *et al*. 2005) showed that parental

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suicide was associated with offspring risk of bipolar disorder compared with offspring of two living parents in a model adjusted for offspring age and gender, parental age and family psychiatric disorders (aOR 2.16, 95% CI 1.25–3.08). However, unadjusted analysis (Tsuchiya *et al*. 2005) did not provide clear evidence of an increased risk of bipolar disorder in offspring of suicide decedents compared with offspring whose parent died by a cause other than suicide (OR 2.1, 95% CI 0.95–3.2).

Only in one study (Kuramoto *et al*. 2010) did the analysis compare outcomes in offspring who lost a parent to suicide directly with those of offspring who lost a parent to another cause, to provide adjusted estimates of the strength of association (we have made this comparison for several additional studies using extracted summary statistics, so obtaining crude estimates). Following adjustment for parent's psychiatric disorder, the investigators (Kuramoto *et al*. 2010) found that the former had a small increase in risk of suicide attempt (OR 1.18, 95% CI 0.99–1.37) and depressive disorder (OR 1.33, 95% CI 1.05–1.60). (This study was excluded from the meta-analyses as it overlapped with Wilcox *et al*. 2010.)

Maternal compared with paternal suicidal behaviours

Of the two studies that compared the association of maternal and paternal death by suicide with suicidal behaviour in their offspring, one (Agerbo *et al*. 2002) found a larger effect size for mothers while the other (Mittendorfer-Rutz *et al*. 2008) found approximately equal risk for suicide attempt associated with maternal and paternal suicide (Table 2). Three studies (Sorenson & Rutter, 1991; Pfeffer *et al*. 1998; Mittendorfer-Rutz *et al*. 2008) found that maternal suicide attempt was more strongly associated with offspring suicide attempt than paternal suicide attempt (Table 2).

Kessing *et al*. (2004) found that maternal but not paternal suicide increased the risk of bipolar disorder and Kuramoto *et al*. (2010) found that the risk of major depression was slightly higher following maternal compared with paternal suicide (Table 2).

The effect of parental suicidal behaviour on male and female offspring

Five studies reported on the association of parental suicidal behaviour separately for female and male offspring (Table 3). Two studies (Sorensen *et al*. 2009; Gravseth *et al*. 2010) reported that suicide risk was markedly larger in daughters than in sons. In contrast, loss of a parent to suicide was associated with slightly higher risk of suicide attempt in sons than in daughters (Mittendorfer-Rutz *et al*. 2008).

Two studies assessed the gender-specific effect of parental suicide attempt. While one (Goodwin *et al*. 2004) found larger effect size on the risk of suicide attempt in males, the other (Mittendorfer-Rutz *et al*. 2008) reported similar effect in both.

One study (Kessing *et al*. 2004) reported no significant interaction between parental suicide and offspring gender in relation to bipolar disorder (results were not presented).

The effect of age of exposure to parental suicidal behaviour

One study addressed offspring age at exposure to parental suicidal behaviour in relation to their subsequent risk of suicidal behaviour. Controlling for both parents' psychiatric hospitalization and criminal conviction, Wilcox *et al*. (2010) showed that offspring who lost a parent to suicide during childhood (0–12 years) and adolescence (13–17 years) were three times more likely to die by suicide [adjusted incidence rate ratio (aIRR) 3.0, 95% CI 1.70–5.30; aIRR 3.1, 95% CI 2.10–4.60, respectively] compared with offspring of two living parents of the same age group, but there was no increase in risk if the offspring was 18–25 years at the time of parental suicide (aIRR 1.3, 95% CI 0.9–1.9; interaction – children *v*. young adults: $p = 0.01$, adolescents *v*. young adults: $p = 0.001$). In contrast, there was no differential effect of age at parental suicide on offspring risk of suicide attempt (all $p > 0.05$).

Tsuchiya *et al*. (2005) reported that paternal suicide was not associated with risk of bipolar disorder in the three age groups (0–9, 10–19, and 20+ years) investigated. Exposure to maternal suicide, however, had an effect on offspring risk of bipolar disorder at all age groups but the effect size was the largest in the 0–9 age group (aIRR 7.30, 95% CI 2.12–25.10; aIRR 3.06, 95% CI 1.37–6.84; aIRR 2.87, 95% CI 1.09–7.11, respectively). Wilcox *et al*. (2010) found no differential effect of age at parental suicide on offspring risk of depressive disorder.

Discussion

Main findings

Our meta-analysis found that fatal as well as non-fatal parental suicidal behaviour generally increased the risk of suicidal behavior in their offspring approximately 2- to 3-fold. Controlling for key sociodemographic variables and parental/offspring psychopathology reduced this risk by 20–50%, and led to an

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Table 2. *Relationship between maternal and paternal suicidal behaviour and the risk for suicidal behaviour and depression in offspring grouped by form of parental suicidal behaviour*

First author	Year	Outcome	Comparison group(s)	ES by parent gender		Factors controlled for in analysis		
				Mother, ES (95% CI)	Father, ES (95% CI)	Offspring age and gender	Offspring psychopathology	Parental psychopathology
Parental suicide								
Agerbo	2002	Suicide	No parental death	1.0	1.0	Yes	Yes	Yes
			Parental death by suicide	RR 7.55 (3.74–15.30) aRR 4.75 (2.10–10.80)	RR 3.80 (1.99–7.26) aRR 2.30 (1.10–4.80)			
Mittendorfer-Rutz	2008	Suicide attempt	No parental death	1.0	1.0	Yes	Yes	Yes
			Parental death by suicide	RR 3.13 (2.50–3.90) aRR 1.79 (1.30–2.40)	RR 2.88 (2.50–3.30) aRR 1.90 (1.60–2.30)			
Kessing	2004	Bipolar disorder	No parental death	1.0	1.0	Yes	No	Yes
			Parental death by suicide	RR 5.75 (3.02–10.96) aRR 3.94 (1.99–7.80)	RR 2.00 (0.92–4.35) aRR 1.29 (0.57–2.91)			
Kuramoto	2010	Major depression	Parental death by accident	1.0	1.0	Yes	No	Yes
			Parental death by suicide	RR N/R (N/R) aRR 1.61 (0.99–2.61)	RR N/R (N/R) aRR 1.29 (1.03–1.61)			
Parental suicide attempt								
Pfeffer	1998	Suicide attempt	No parental suicide attempt	1.0	1.0	No	Yes	No
			Parental suicide attempt	RR 6.84 (N/R) aRR 7.33 (1.70–31.60)	RR N/R (N/R) aRR 1.15 (0.79–1.69)			
Mittendorfer-Rutz	2008	Suicide attempt	No parental suicide attempt	1.0	1.0	Yes	Yes	Yes
			Parental suicide attempt	RR 4.23 (3.9–4.5) aRR 2.75 (2.5–3.1)	RR 3.33 (3.0–3.6) aRR 1.88 (1.7–2.1)			
Sorenson	1991	Suicide attempt	No parental suicide attempt	1.0	1.0	No	No	No
			Parental suicide attempt	RR 6.89 ($p<0.001$) aRR N/R (N/R)	RR 3.36 ($p<0.05$) aRR N/R (N/R)			

ES, Effect size; CI, confidence interval; RR, risk ratio; aRR, adjusted risk ratio; N/R, not reported.

Table 3. *Relationship between parental suicidal behaviour and the risk for suicidal behaviour and depression in female and male offspring grouped by form of parental suicidal behaviour*

				ES by offspring gender	
First author	Year	Outcome	Comparison group(s)	Daughters, ES (95% CI)	Sons, ES (95% CI)
Parental suicide					
Gravseth	2010	Suicide	No parental suicide	1.0	1.0
			Offspring of parents who died by suicide	RR 6.37 (3.57–11.4) aRR[a] 5.11 (2.79–9.35)	RR 2.12 (1.33–3.37) aRR[b] 1.62 (1.00–2.60)
Sorensen	2009	Suicide	No parental suicide	1.0	1.0
			Offspring of parents who died by suicide	RR 10.18 (3.31–31.21)	RR 2.50 (0.60–10.47)
Mittendorfer-Rutz	2008	Suicide attempt	No parental suicide	1.0	1.0
			Offspring of parents who died by suicide	RR 2.69 (2.24–3.13)	RR 3.44 (2.73–4.15)
Kessing	2004	Bipolar disorder	No parental suicide	No difference between men and women in the effect of parental suicide or other death (results not presented)	
			Offspring of parents who died by suicide		
Parental suicide attempt					
Goodwin	2004	Suicide attempt	No parental suicide attempt	1.0	1.0
			Parental suicide attempt	RR 3.4 (2.14–5.28)	RR 6.8 (3.75–12.38)
Mittendorfer-Rutz	2008	Suicide attempt	No parental suicide attempt	1.0	1.0
			Parental suicide attempt	RR 3.7 (3.42–3.98)	RR 3.9 (3.51–4.29)

ES, Effect size; CI, confidence interval; RR, risk ratio; aRR, adjusted risk ratio; N/R, not reported.

[a] Analysis was adjusted for age, birth weight, childhood benefit due to chronic disease, residence at age 16 years, birth order, maternal marital status, parental disability, parental education, offspring education, offspring disability pension, offspring intellectual performance, mental health measured as a conscript, body mass index as a conscript.

[b] Analysis was adjusted for age, birth weight, childhood benefit due to chronic disease, residence at age 16 years, birth order, maternal marital status, parental disability, parental education, offspring education, offspring disability pension.

uncertain conclusion concerning the impact of parental suicide on offspring suicide attempt.

In contrast, based on the limited published literature available it is unclear whether or not parental suicidal behaviour is associated with an increased risk of affective disorders. There is some indication that exposure to parental suicide is associated with subsequent depression and offspring risk of bipolar disorder. However, studies focused almost exclusively on the effect of exposure to parental suicide.

The review further suggests that exposure to maternal suicidal behaviour is a greater risk for suicidal behaviour and depression compared with paternal suicidal behaviour. These findings are consistent with other research findings. Stenager & Qin (2008), for example, found that maternal psychiatric history constituted a substantial higher risk factor for suicide in young people than paternal psychiatric history. It may be that maternal behaviour is a stronger influence on offspring learnt behaviour and coping strategies or that insufficient maternal care, resulting from psychiatric morbidity, is more strongly related to child's mental health because mothers are usually the primary caregiver.

It is unclear, however, whether daughters and sons differ in their response to parental suicidal behaviour. Other related studies have noted a difference in the effect of parental loss (McLeod, 1991) and parental psychiatric history (Stenager & Qin, 2008) on daughters and sons in terms of suicidal behaviour and depression, both identifying stronger relationships in daughters than sons. Interestingly, one of the studies reviewed here (Mittendorfer-Rutz *et al*. 2008) presented effect estimates for mothers and fathers separately for daughters and sons. This analysis showed that while loss of a mother through suicide was associated with similar effect size in their sons and daughters, loss of a father resulted in a somewhat larger effect size for sons (OR 3.5, 95% CI 2.7–4.4) than for daughters (OR 2.6, 95% CI 2.1–3.1), suggesting that maternal and paternal suicidal behaviours are differentially associated with outcomes in daughters and sons.

Based on the available evidence it is also unclear whether the age of offspring at exposure to parental suicidal behaviour plays a role in the association of parental suicidal behaviour and offspring psychopathology. A large (*n* about 700 000) and methodologically robust study (Wilcox *et al*. 2010), which appropriately controlled for parental psychiatric history but not for child psychiatric history (see below) and for clustering, i.e. multiple children of the same parent, suggests that effects may be somewhat stronger in individuals who were younger when their parent died by or attempted suicide. This finding is in keeping with Tsuchiya *et al*. (2005), who reported that maternal suicide had the greatest effect on offspring risk of bipolar disorder when exposure occurred during childhood (age 0–9 years). However, there was no differential effect of age at parental suicide on offspring risk of suicide attempt or depressive disorder (Wilcox *et al*. 2010).

It has been argued that studies addressing the effect of parental death by suicide should compare outcomes in offspring of suicide decedents with those of offspring bereaved by other causes in order to control for the stress and disruption associated with parental loss (Hung & Rabin, 2009; Kuramoto *et al*. 2010). Whilst several studies did have such a comparison group, just one study compared suicide risk in offspring of suicide decedents directly with that of offspring who lost a parent to another cause (Kuramoto *et al*. 2010), finding that the former had an increased risk of suicide attempt (OR 1.37, 95% CI 1.19–1.54). This association was reduced following adjustment for parental psychiatric disorder (OR 1.18, 95% CI 0.99–1.37). Similarly, there was weak evidence of an increased risk of affective disorders in offspring who lost a parent to suicide compared with another cause (Kuramoto *et al*. 2010).

Strengths and limitations

We have reviewed twice as many studies as previous reviews, and many of the new papers, published in the last 3 years, are more methodologically robust and include larger sample sizes than previous investigations. Furthermore, we have assessed the impact of both fatal and non-fatal parental suicidal behaviours and gender- and age-specific effects.

Nevertheless, it is important to note several limitations to our findings. First, many of the studies reviewed here were based on data obtained through population registers. Although these studies are large, yielding high statistical power for the analysis of main effects and effect modifiers, they are limited to psychiatric disorders for which individuals receive in-patient or in some cases out-patient treatment. Indeed, two Danish population studies showed that only 45% of individuals who attempted suicide had been hospitalized for this problem (Kjoeller & Helweg-Larsen, 2000) or that 37% of all suicide attempts were correctly registered in the Danish National Patient Registry (Nordentoft & Sogaard, 2005). Second, all the studies reviewed here were carried out in developed countries (USA, Western Europe) including primarily Caucasian populations, therefore limiting the generalizability of our findings. Third, many of the studies that attempted to control for the effect of confounders adjusted their analysis for offspring psychiatric history. Offspring psychopathology may be either a mediating or a

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moderating factor but is unlikely to be a confounder in the association of parental suicidal behaviour with offspring suicidal behaviour and/or depression. Conditioning on factors in the causal pathway of this relationship may have led to an underestimation of the true association (Hernan *et al*. 2002). Last, one should be cautious about using only single overall estimates in the presence of considerable heterogeneity in study methodology, although it is worth noting that the findings appear reasonably consistent across the reviewed studies. A formal examination of the extent and causes of heterogeneity was precluded by the limited number of studies in each meta-analysis

Mechanisms

Several mechanisms may explain the association of parental suicidal behaviour with offspring suicidal behaviour and depression. First, the mechanism may be environmental, involving learned parental behaviour (social contagion/imitation) or a direct adverse impact of parental suicidal behaviour on childhood environment. Parental suicidal behaviour may lead to, or exacerbate, offspring psychopathology because it is associated with unfavourable changes in the offspring environment. The difference we noted in risk in relation to whether the suicidal behaviour occurred in the father or mother points to a possible environmental cause as both parents contribute equally to their offspring's genotype. Second, suicidal behaviour and depression in offspring are likely to be influenced by the same genetic predisposition to suicidal behaviours or other mental disorder that caused suicidal behaviour in their parents. Studies show that a family history of suicidal behaviour increases the risk of suicidal behaviours in relatives (Brent *et al*. 2002). Furthermore, evidence from adoption studies show elevated risk of suicide among the biological relatives of adoptees that died by suicide compared with relatives of non-suicidal adoptees (Schulsinger *et al*. 1979; Wender *et al*. 1986). Twin studies also show greater concordance in suicidal behaviours among monozygotic compared with dizygotic twins (e.g. Statham *et al*. 1998; Fu *et al*. 2002). It is likely, however, that genetic susceptibility combined with adverse environmental conditions (Roy *et al*. 2000) contribute to the observed association.

Impulsive aggression has been identified as an important predictor of suicidal behaviour (Brent *et al*. 2003; Melhem *et al*. 2007). This trait, which was shown to aggregate in families with suicidal behaviour (Brent *et al*. 2003; Melhem *et al*. 2007), may explain the familial transmission of suicidal behaviour (Bronisch & Lieb,. 2008). Impulsive aggression too may be genetically (Brent & Mann, 2005) or non-genetically transmitted (Brent *et al*. 2002).

Interestingly, our findings showed that parental suicidal behaviour confers an increased risk of offspring suicidal behaviour and affective disorder even after controlling for parental history of psychiatric disorder, highlighting the independent contribution of parental suicidal behaviour to offspring psychopathology. Nevertheless, information on parental psychiatric history was derived from population registers including only the more severe psychiatric disorders. It would be interesting to assess this association controlling for more minor parental psychiatric disorders.

Implications for practice and for future research

This review suggests that offspring exposed to parental suicidal behaviour, regardless of the form or context of suicidal behaviour, i.e. suicide or suicide attempt, parental gender or the age and gender of offspring, are at a greater risk of suicidal acts themselves and thus may benefit from intervention ('postvention') strategies (Brown *et al*. 2007; Mitchell *et al*. 2007).

Our data also suggest that it may be beneficial to identify vulnerable subgroups within this broader group of offspring. The review suggests that offspring exposed to maternal suicide or suicide attempt may be at a greater risk for subsequent adverse outcomes than those experiencing paternal suicidal behaviour and that children may be more vulnerable than teenagers and adults. Nevertheless, more studies are needed that assess the age-specific impact of parental suicidal behaviour. It is unclear, however, whether daughters and sons differ in their response to parental suicidal behaviour, as research findings were inconsistent and further research is needed on this issue. Future studies may need to consider maternal and paternal suicidal behaviour separately for daughters' and sons' outcomes.

Much of the empirical work to date has been based on population registers or clinical samples which are limited to more severe psychiatric disorders. Information on minor psychiatric conditions which are more prevalent in the population and thus may have greater implications for public health is lacking. Data are required from large well-controlled studies that assess psychiatric symptoms in parents as well as in offspring through standardized assessment tools. These studies should investigate parental impulsive aggression as a possible mechanism linking parental and offspring suicidal behaviour.

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Declaration of Interest

None.

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