**Sudden Parental Death from External Causes and Risk of Suicide in the Bereaved
Offspring: A National Study**

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Abstract

Previous research has revealed an association between parental bereavement from external causes and risk of suicide in offspring. Few studies have however provided insights into specific influences of cause of death, gender of the deceased and bereaved, age at bereavement and suicide, and time since bereavement. The present nested case-control study was based on data from three longitudinal registers. Subjects comprised 19 015 persons who died from suicide at an age of 11-64 years during 1969-2012 (cases), and 332 046 live comparison individuals matched for gender and date of birth. Information about deceased parents' cause and date of death, and sociodemographic data was retrieved and merged. Data were analysed with conditional logistic regression. Losing a parent to suicide, transport accidents and other external causes of death was associated with an increased suicide risk in offspring. Parental suicide was associated with a substantially higher suicide risk than transport accidents and other external causes. These effects were equally strong for daughters and sons, and for the loss of a mother, father or both parents. Suicide risk was highest in younger bereaved offspring, and bereavement had both short and long-term impacts on suicide risk. In conclusion, all offspring exposed to parental death by external causes have an increased suicide risk, independent of factors related to the exposure. The consequences are long lasting, and offspring should be offered follow-up in primary healthcare. Younger offspring bereaved by parental suicide have the highest risk and may be targeted for prevention and intervention programs in specialist healthcare.

Keywords: Suicide, bereavement, population registers, Norway

Introduction

Every year, more than 3 million people die a sudden death due to accidents, suicide, homicide or other external causes of death worldwide (World Health Organization, 2015). Consequently, a considerable number of offspring suffer sudden parental loss due to external causes of death, and such loss is one of the most significant and traumatic life events that individuals can face (Bowlby, 1980). Among the most severe adverse outcomes that may arise in offspring from sudden parental death are increased risks of suicide (Agerbo et al., 2002; Cheng et al., 2014; Gravseth et al., 2010; Guldin et al., 2015; Niederkrotenthaler et al., 2012; Wilcox et al., 2010), suicidal ideation (Jeon et al., 2013), and suicide attempts (Jakobsen and Christiansen, 2011; Kuramoto et al., 2010; Mittendorfer-Rutz et al., 2012). The risk of suicide completion, for instance, is reported to be at least two times higher among offspring bereaved by parental death by external causes compared to individuals who have not experienced such bereavement (Agerbo et al., 2002; Guldin et al., 2015; Niederkrotenthaler et al., 2012), and one study has even reported a fivefold risk (Gravseth et al., 2010).

It is evident that parental bereavement is associated with an increased suicide risk in offspring, however, findings from empirical studies are sparse and inadequate with respect to the potential effects of the specific cause of death, gender of the bereaved, gender of the deceased, age at bereavement and time since bereavement. This is information that may aid health personnel to identify individuals at high risk and better pinpoint the targets of prevention and intervention programs.

In particular, it is widely believed that offspring bereaved by parental suicide are at a greater risk of adverse psychosocial outcomes than offspring bereaved by other causes of death. An early comprehensive review concluded that no significant differences were evident between suicide survivors and other bereaved groups regarding general mental health, PTSD symptoms, depression, anxiety and suicidal behavior (Sveen and Walby, 2008). More recently, however, large scale population studies have suggested a somewhat higher risk of suicide associated with parental suicide than parental death by accidents or other causes (Agerbo et al., 2002; Guldin et al., 2015; Niederkrotenthaler et al., 2012; Wilcox et al., 2010).

Furthermore, previous studies have suggested that daughters may be more influenced by parental death than sons with respect to a higher risk of suicide attempts and completed suicide (Gravseth et al., 2010; Mittendorfer-Rutz et al., 2012), but previous register based

studies have only performed separate analyses for daughters and sons and refrained from directly comparing suicide risk based on gender (Gravseth et al., 2010). Likewise, separate analyses of paternal and maternal bereavement suggested that maternal bereavement was associated with a somewhat higher suicide risk in offspring (Agerbo et al., 2002). When gender of the bereaved offspring and gender of the deceased parent was studied in combination in a recent study, however, loss of the same-sex parent seemed to have the greatest impact on suicide risk (Cheng et al., 2014). Because this study had a low sample size and suffered from a lack of statistical power, an analysis of the potential interaction between gender of the deceased and bereaved with a large sample is needed.

There is only a limited number of population studies that have investigated the effect of parental loss at different ages on suicide risk in offspring (Niederkrotenthaler et al., 2012; Wilcox et al., 2010), and no study has, to our knowledge, investigated parental bereavement from birth and until late adulthood. Time elapsed since bereavement may also influence suicide risk, and studies have suggested that the time period shortly following parental bereavement may be associated with the greatest risk of suicide attempt (Jakobsen and Christiansen, 2011; Mittendorfer-Rutz et al., 2012). The potential influence of time since bereavement on risk of completed suicide in offspring has, however, not yet been investigated in register studies.

In this national population study based on longitudinal registers, our aim was to assess the influence of sudden parental death by external causes on risk of completed suicide in offspring. Given the focus on death by external causes, parental bereavement by natural death was not studied. In particular, we aimed to study whether there is an increased suicide risk in offspring bereaved by parental death due to external causes in the Norwegian population, and especially to assess the specific effects of a) cause of parental death, b) gender of the deceased parent, c) age at bereavement and time since bereavement, and d) offspring's gender and age at suicide/matching.

120 **Method**

121 **Data Sources**

122 We retrieved individual data from three Norwegian longitudinal registers and merged
123 them by means of the personal identification number.

124 The first register is the Cause of Death Register which records the cause and date of all
125 deaths in Norway and has been computerized since 1969. Cause of death has been recorded
126 according to ICD-8 (International Classification of Diseases, Eighth Revision) from 1969 to
127 1985, ICD-9 from 1986 to 1995 and ICD-10 from 1996 to 2012 (Statistics Norway, 2012).

128 The second register is the Central Population Register, computerized since 1964,
129 which contains a personal identifier for all individuals residing in Norway and their links to
130 parents and offspring. These links were utilized in order to identify the mother and father of
131 individuals in the register. However, a proportion of the population has no registered link to
132 parents because a) the person was not living with a parent in 1964, b) the person immigrated
133 to Norway as an adult, c) the parent died before 1964, or d) the parent had emigrated from
134 Norway before 1964. In our dataset, 245 584 subjects (70.0 %) had a link to their mother and
135 236 731 subjects (67.4 %) had a link to their father. Of people with a casedate (date of suicide
136 or matching) in 1969, 17.6 % had a link to their mother and 15.0 % had a link to their father.
137 These proportions increased with time and reached 85.8 % for mothers and 84.4 % for fathers
138 in 2012.

139 The third register is the Statistics Norway's events database (the so-called FD-Trygd
140 database) which is available from 1992 and contains further demographic and socioeconomic
141 data, such as information on marital status, education, income and ethnicity.

142 The study was approved by the Regional Ethics Committee South East Norway and
143 owners of the relevant registers.

144 **Study Design and Population**

145 Suicide cases between 11 and 64 years old were identified from the Cause of Death
146 Register using codes E95 (ICD-8 and ICD-9), X60-X84 and Y870 (ICD-10). We selected this
147 age group because they were likely to have registered links to parents in the Central
148 Population Register. A total of 19 015 suicide cases were retrieved for the period from
149 January 1st 1969 to December 31st 2012. A nested-case control design (Clayton and Hills,

1993) was applied to select up to 20 live controls for each suicide case. Controls were matched for date of birth, gender and the date of suicide and were drawn from a 25% random sample of the national population registered in the Central Population Register at the date of the suicide. This procedure resulted in 332 046 matched controls.

Variables

The variable of interest in the study is exposure to parental death by external causes, referred to as parental DBEC and coded as E800-E999 in ICD-8 and 9 and V01-Y89 in ICD-10. For all subjects with a link to their parents, we retrieved data for both mother and father on DBEC from the Cause of Death Register by the date of suicide for cases or the date of matching for controls. For parents who had died from external causes, we grouped their causes of death into suicide (ICD-8 and ICD-9: E95, ICD-10: X60-X84 and Y870), transport accident, including land, water and air transport methods (ICD-8 and ICD-9: E80-E84 and E920, ICD-10: V01-V99), or other external causes of death such as other accidents, homicide and injury with unknown intent (ICD-8 and ICD-9: E85-E95, E96-E999, ICD-10: W00-W89, X00-X60, X85-Y09, Y10-Y30, Y30-Y90). If subjects had a link to only one parent, they were classified according to the status of that parent for all variables described below. Based on maternal and paternal bereavement status, subjects were classified into three main categories of *bereavement status*: a) no exposure to parental DBEC, b) exposure to parental DBEC, and c) no link to either parent.

Gender of deceased parent was classified as a) no exposure to parental DBEC, b) maternal DBEC, c) paternal DBEC, d) DBEC of both parents, and e) no link to either parent. We classified *cause of death* as a) no exposure to parental DBEC, b) suicide, c) transport accidents, d) other external causes, and f) no link to either parent. Subjects were classified according to their *age at bereavement* into a) no exposure to parental DBEC, b) 0-9 years (childhood), c) 10-17 years (adolescence), d) 18-24 years (young adulthood), e) 25-44 years (adulthood), f) 45-64 years (late adulthood), and g) no link to either parent. This classification was based on the United Nations standard age classifications (United Nations, 1982) and WHO's definition of adolescence (World Health Organization, 2016). *Time since bereavement* refers to the time span between parental death and suicide/matching, and subjects were classified into a) no exposure to parental DBEC, b) up to one year, c) 1-4 years, d) 5-9 years, e) 10-14 years, f) 15 and more years, and g) no link to either parent. If parents died at separate

times or from different causes, age at bereavement, time since bereavement and cause of death were classified according to the parent who died first.

For subjects included from the year 1992 (when the Event database was established), we retrieved socioeconomic information for variables where previous research has found strong associations with suicide (Qin et al., 2003). *Marital status* was classified as a) married, b) never married, c) separated, d) divorced, e) widowed and f) unknown. *Ethnicity* was classified as a) born in Norway with two Norwegian born parents, b) immigrant, c) born in Norway with immigrant parents or one parent born abroad, and d) born abroad with one or two Norwegian born parents. *Education* was classified as a) compulsory education (primary and lower secondary education), b) upper secondary education, c) post-secondary non-tertiary education, d) bachelor's degree, e) master's or doctoral degree, and f) no education, preschool education or unknown. *Income* was classified as a) 100 000 NOK or less, b) 100 001 – 200 000 NOK, c) 200 001 – 300 000 NOK, d) 300 001 – 400 000 NOK, e) 400 001 NOK or more, and f) unknown. Information concerning marital status and education was based on registered status at the date of suicide or matching for the controls, while information concerning income was in the record the year before the year of suicide or matching.

Statistical Analyses

All analyses were conducted using IBM SPSS Statistics, version 22 (IBM Corp, 2013). The outcome variable was completed suicide, and suicide risk was estimated by a conditional logistic regression analysis. Odds ratios (ORs) and 95 % confidence intervals (95%CI) were estimated, and the Wald test was utilized to investigate whether the odds ratios were significantly different from the reference.

Firstly, univariate analyses yielded crude ORs controlled for age, gender and calendar time through matching for the data period 1969-2012. Secondly, multivariate analyses yielded adjusted ORs further adjusted for marital status, income, education and ethnicity for the data period 1992-2012. Furthermore, interactions between variables of study with gender and age were assessed with the log likelihood ratio test based on results from the multivariate analyses. Lastly, we assessed the interaction between age at bereavement and time since bereavement and the interaction between cause of death and gender of deceased. The reference category was “no exposure to parental DBEC” for all analyses.

Results

In the present study, 73.4 % (N=13 950) of suicide cases were male. The mean age at death was 39.3 years (SD = 13.6), 41.1 (SD = 13.5) for females and 38.7 (SD = 13.6) for males. Table 1 displays the distribution of the study variable categories among the suicide cases and their matched comparison subjects.

Table 2 presents the results of the univariate (crude ORs) and multivariate (adjusted ORs) conditional logistic regression analyses examining suicide risk associated with variables under study. The crude analyses for 1969-2012 showed a significantly increased suicide risk in offspring who had experienced parental DBEC compared to offspring who had not experienced parental DBEC, and this effect remained significant after adjustment for socioeconomic variables.

Cause of Death and Gender of Deceased

Offspring bereaved by parental suicide, transport accidents and other external causes of death all showed a significantly increased suicide risk compared to offspring who had not experienced parental DBEC. Parental suicide was associated with a substantially higher suicide risk than transport accidents and other external causes (Table 2).

When investigating gender of the deceased parent, losing a mother, father and both parents were all associated with a significantly increased suicide risk compared to no parental bereavement from external causes. No differences were evident between losing a mother and a father, but the risk associated with losing both parents was somewhat higher compared to losing one parent (Table 2). The effect of gender of deceased did not significantly differ by cause of death (Cause of death interaction test: $p=.57$)

Age at Bereavement and Time since Loss

When investigating offspring's age at bereavement, parental bereavement was associated with a significantly increased suicide risk when bereavement occurred from birth and throughout adulthood (age 45), but not when bereavement occurred in late adulthood (age 45-64). The odds ratio was highest when offspring experienced bereavement during childhood and adolescence (before age 18) (Table 2).

When investigating the time since bereavement, suicide risk was not significantly increased the first year after bereavement, but was significantly increased from a year after

bereavement and throughout late adulthood. From a year after bereavement, minimal differences between time periods were evident (Table 2).

The effect of age at bereavement differed significantly by time since bereavement (Time since bereavement interaction test: $p < .00001$). Subjects in the ages 10 to 44 years had a very increased suicide risk the first year after bereavement and more than 15 years after bereavement (Figure 1).

Gender and age differences in suicide risk

There were no significant gender differences in suicide risks associated with bereavement status, cause of death, gender of deceased, age at bereavement or time since bereavement, tested by the log likelihood ratio test (Table 2).

Table 3 depicts separate adjusted analyses for offspring above and below 25 years at suicide or matching and the associated age interaction test. There were significant age differences for the influence of bereavement status, cause of death, gender of deceased, age at bereavement and time since bereavement. Parental bereavement from external causes of death had a stronger effect on risk of suicide at an age under 25 years compared with the risk of suicide above the age of 25. This was apparent across cause of death, gender of deceased parent, offspring's age at bereavement and time since bereavement.

Discussion

In the present study, we found that parental death by all external causes was associated with a significantly increased suicide risk in offspring, and that parental suicide was associated with a substantially higher suicide risk than loss due to transport accidents or other external causes. Furthermore, suicide risk was highest in younger offspring who had experienced parental bereavement. Parental bereavement had, however, both short and long-term effects. The risk did not differ between daughters and sons or between the loss of a mother or father.

The approximately doubled suicide risk in offspring who have experienced parental bereavement due to external causes of death is comparable to the increased risk reported in similar studies (Gravseth et al., 2010; Niederkrotenthaler et al., 2012; Wilcox et al., 2010), and remained significant even after controlling for factors known to highly influence suicidality (Qin et al., 2003). This increased risk of suicidal behavior could be mediated

through psychiatric disorders caused or aggravated by the loss of an important attachment figure such as a parent (Kaplow et al., 2010; Ogata et al., 2011; Shear and Clayton, 2008; Shear and Mulhare, 2008).

Cause of Death in Parents

The results from the current study are in line with the two previous large scale Scandinavian register studies examining the effect of parental bereavement by different external causes of death on risk of completed suicide in offspring (Guldin et al., 2015; Wilcox et al., 2010), all indicating a higher risk associated with parental suicide compared to other external causes of death. This discrepancy was, however, larger in the present study than the other comparable studies.

Several factors combined probably explain why suicide bereaved offspring display a higher suicide risk than offspring bereaved by other external causes of death. Previous studies have found support for a higher suicide risk in offspring of suicides because of genetic transmission of factors reported to highly influence suicidality, such as psychiatric disorders, neurocognitive deficits and certain personality traits (Tidemalm et al., 2011). In addition, studies indicate that an adverse family environment consisting of maltreatment, abuse, psychiatric disorders and family discord is particularly present in families where members have died by suicide (Brent and Melhem, 2008; Melhem et al., 2008). Furthermore, suicide bereaved family and friends report more difficulties related to grief specific variables such as a need to conceal the cause of death, guilt or feelings of responsibility, shame and stigma, family relational disturbance and social isolation, rejection, abandonment and anger at the deceased and a ruminative need to make sense of the death (Jordan, 2001; Shear and Mulhare, 2008; Sveen and Walby, 2008). These grief specific challenges may lead to suicidal behaviour through the development of complicated grief, depression, anxiety, posttraumatic stress disorder (PTSD) or general psychosocial stress (Shear and Clayton, 2008; Shear and Mulhare, 2008).

Gender of Deceased and Bereaved

Our study provided no support for gender differences in offspring suicide risk after parental bereavement. A previous Norwegian cohort study, however, reported higher hazard ratios for suicide in daughters compared to sons, but only included 1406 suicides aged 19 to 37 years old and did not directly compare suicide risk between genders (Gravseth et al., 2010).

Moreover, suicide risk did not substantially differ following the loss of a mother or father, and there was no significant interaction between the gender of the deceased parent and the gender of the bereaved offspring. There was, nevertheless, a slight tendency for maternal bereavement to be associated with a larger suicide risk than paternal bereavement, and Agerbo and colleagues (2002) reported a difference in suicide risk in the same direction. This latter study, however, included a mere 496 suicide cases aged 10 to 21 years old compared to the large amount of suicide cases between 11 and 64 years old in the present study. The gender of the deceased parent and consequently the gender of the remaining parent hence seem to be of limited importance to the risk of completed suicide in bereaved offspring. This lack of gender differences may reflect a high level of gender equality in Norway in the given time period. Factors that have traditionally differed between mothers and fathers, such as the role of primary caregiver, displays of affection and personal attachment, are now probably more individually based and vary between families. Likewise, the offspring's primary role model may no longer necessarily be the parent of the same sex, but may differ between different families. Future register studies will naturally need to confirm the present results.

There was a tendency for bereavement of both parents to lead to a greater suicide risk in offspring compared to losing one parent, but we are unable to conclude that losing both parents is associated with a larger suicide risk because of low statistical power. The loss of both parents in childhood or adolescence will probably lead to extensive changes in care-taking routines and residence since the offspring will be in the care of child protective services.

Age at Parental Death and Offspring Suicide

The present study is, to our knowledge, the first study to provide a detailed analysis of the ages at bereavement and suicide throughout late adulthood, and indicated that suicide risk is significantly increased when bereavement occurs until age 45, but not in late adulthood. We consistently found that the increased suicide risk accompanying parental bereavement is most pronounced relatively early in life, before the age of 18, and these results are in accordance with a comparable previous register study (Wilcox et al., 2010). Adolescence is a highly important period for later development (Schooling, 2015; Viner et al., 2015), and exposure to traumatic events during this critical period can have a more detrimental effect than if exposure occurs at other ages (Kuh et al., 2003). Adolescence may be a critical period because of the large biopsychosocial changes occurring in this period (Viner et al., 2015), the influence of

puberty (Schooling, 2015), the time discrepancy between biological and psychological transitions (Patton and Viner, 2007) and the higher degree of impulsivity and emotional turmoil experienced by most adolescents (Casey et al., 2010).

When sudden parental bereavement and risk of completed suicide are considered together throughout most of the lifespan, the effect of age at bereavement differs significantly by time since bereavement; Suicide risk is most pronounced either directly following bereavement, or after more than 15 years. Since sudden parental bereavement evidently is associated with both short term and long term effects, both the trauma of the event itself and the developmental challenges following parental loss probably contribute to offspring's increased suicide risk. While the short term effect directly following bereavement may be due to the trauma and loss itself, the long term effects are probably the result of developmental challenges related to growing up in a one-parent home without a very important attachment figure. Additionally, genetic heritability of suicidal behavior may contribute to the long term effects of parental suicide (Tidemalm et al., 2011).

Limitations and Strengths

The findings of the present study must be interpreted in light of some limitations. We did not include sudden parental death by illness or sudden loss of a sibling, and these types of bereavement may also constitute a substantial trauma. Information concerning factors that may explain the observed effects such as family environment, living situation or genetic vulnerability was not available in our registers. Moreover, limited data access did not allow us to include information on potential parental psychiatric disorders, or information concerning the quality of the relationship between the offspring and the deceased or remaining parent.

The utilization of national longitudinal registers enables the inclusion of a large number of subjects, yielding greater statistical power. Furthermore, the utilization of national registers enables us to follow subjects and their parents for most of their lifespan. Data in Norwegian registers are collected systematically and uniformly and cover all suicides in the entire population. The control sample was randomly selected and highly representative of the general population. This may reduce the risk of biases often associated with for example sampling, observation or interviewing.

Conclusions and Implications

In conclusion, losing a parent to external causes of death, and especially suicide, is associated with a significantly increased suicide risk in offspring, regardless of gender of offspring or parent. Suicide risk is highest in younger offspring who have experienced parental bereavement, and bereavement has both short and long-term effects.

The present study expands the knowledgebase and yields increased insight, especially into the effect of timing of bereavement and offspring suicide. The investigation is thorough compared to several previous studies where parental death is merely one of numerous risk factors investigated (Agerbo et al., 2002; Gravseth et al., 2010), different external causes of parental death are not compared (Agerbo et al., 2002; Niederkrotenthaler et al., 2012), or bereavement is studied in an age-restricted sample (Agerbo et al., 2002; Gravseth et al., 2010; Guldin et al., 2015; Niederkrotenthaler et al., 2012; Wilcox et al., 2010). Future research should aim to gain the same increased insight into the specific effects of parental bereavement for other outcome measures, such as psychiatric disorders, self-harm and school performance, and investigate their potential role as mediators between parental bereavement and offspring suicide.

We believe that the knowledge produced in the present study is of relevance to the large accumulated number of offspring who become exposed to sudden parental death by indicating the conditions under which bereaved offspring are most vulnerable. Since all offspring bereaved by parental death due to external causes have an increased suicide risk, all bereaved offspring should be offered follow-up in primary healthcare. Furthermore, increased insight into the relationship between offspring suicide and the influencing factors cause of death, age and gender may aid health personnel in primary care to effectively identify at-risk individuals, and the findings from the present study should be incorporated into suicide risk assessments. Our findings call for an emphasized focus on young people who have been bereaved through suicide, and these groups may be targeted for prevention and intervention programs in specialist healthcare. Given the significantly higher suicide risk associated with parental suicide compared to other external causes of death as well as the grief specific challenges experienced by this group, suicide bereaved should be offered separate support groups and intervention programs. Indeed, preventive efforts targeting bereaved people have emerged over the last two decades and specific support programs for people bereaved through suicide have been developed (Andriessen, 2004). Only by pinpointing the conditions associated with the greatest suicide risk in bereaved offspring can society tailor and implement effective prevention and treatment programs for this vulnerable group.

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Figures

Figure 1. Odds ratio for suicide associated with Age at bereavement by Time since
bereavement^a

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515 ^a The ORs derived from this model were based on data from 1992 to 2012 and adjusted for marital status,
516 income, education and ethnicity. The P value for the Time since bereavement interaction test was <.00001.
517 The group “No link to either parent” is included in the analyses but not listed in the table.
518 The group aged 45 to 64 was excluded from the multivariate analysis due to reduced degrees of freedom because
519 of linearly dependent covariates.

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530 *The authors prefer to have figure 1 with color both online and in print.*

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