

Research paper

Risk factors for suicide in offspring bereaved by sudden parental death from external causes



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ABSTRACT

Background: Parentally bereaved offspring have an increased suicide risk as a group, but the ability to identify specific individuals at risk on the basis of risk and protective factors is limited. The present study aimed to investigate to what degree different risk factors influence suicide risk in offspring bereaved by parental death from external causes.

Methods: Based on Norwegian registers, individual-level data were retrieved for 375 parentally bereaved suicide cases and 7500 parentally bereaved gender- and age-matched living controls. Data were analysed with conditional logistic regression.

Results: Bereaved offspring with low social support, indicated by offspring's single status and repeated changes in marital status and residence, had a significantly increased suicide risk compared to bereaved offspring with high social support. Moreover, low socioeconomic status, having an immigration background, having lost both parents and loss due to suicide significantly increased suicide risk.

Limitations: Several variables relevant to bereavement outcome, such as coping mechanisms and the quality of the parent-offspring relationship are impossible to examine by utilizing population registers. Moreover, the availability of data did not enable the measurement of marital stability and residence stability across the entire lifespan for older individuals.

Conclusions: Healthcare professionals should be aware of the additional risk posed by the identified risk factors and incorporate this knowledge into existing practice and risk assessment in order to identify individuals at risk and effectively target bereaved family and friends for prevention and intervention programs. Ideal follow-up for bereaved families should include a specific focus on mobilizing social support.

1. Introduction

Although the majority of people who have experienced sudden parental death return to their normal life functioning following a period of grief, research has consistently reported that bereaved offspring have an elevated risk of suicide (Agerbo et al., 2002; Gravseth et al., 2010; Guldin et al., 2015; Niederkrotenthaler et al., 2012; Wilcox et al., 2010) and suicide attempts (Jakobsen and Christiansen, 2011; Kuramoto et al., 2010; Mittendorfer-Rutz et al., 2012). Few studies, however, have investigated risk factors for completed suicide in parentally bereaved offspring, and no study has investigated several risk factors for suicide in combination in order to investigate their relative importance and potential interaction. In a recent review of risk factors for complicated grief in bereaved people (Burke and Neimeyer, 2012), low socioeconomic status (SES) in the form of low education and income was identified as a risk factor. Lack of social support has additionally been found to highly influence the development of depression and

complicated grief following bereavement (Burke and Neimeyer, 2012; van der Houwen et al., 2010). Similarly, a lack of family cohesion increased suicide risk in bereaved people (Burke and Neimeyer, 2012), and stigma has been reported to attenuate the association between bereavement and suicide (Pitman et al., 2016). A previous study by Garssen et al. (2011) investigated the influence of a limited number of bereavement-related risk factors on risk of completed suicide in bereaved offspring. They reported a larger suicide risk in sons and daughters whose parents died of suicide compared to offspring whose parents died of other causes, and in offspring who lost a mother compared to offspring who lost a father (Garssen et al., 2011).

The reasons for the variation in responses to loss are largely unknown, and the ability to identify individuals at risk of suicide on the basis of risk and protective factors is limited (Stroebe et al., 2006). It is postulated that the influence of parental loss on offspring's psychosocial wellbeing largely depends on the offspring's inter- and intrapersonal resources, as well as the nature of the bereavement (Stroebe et al.,

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2006). The interpersonal resources, such as marital status and number of close friends, may reflect possible social support and community network. The intrapersonal factors, such as income, education and mental health problems, may indicate potential capacities in coping and recovery. Bereavement-related factors include for example the cause of death and the quality of the relationship to the deceased, and may reflect the severity of the loss. A better understanding of the relative effect of these factors has clinical importance in its ability to identify individuals at risk and pinpoint the targets of prevention and intervention programs.

In this national population study based on longitudinal registers, our main aim was to investigate to what degree different interpersonal, intrapersonal and bereavement-related factors influence suicide risk in offspring bereaved by parental death from external causes. We also wanted to examine whether the relative importance of these factors on risk of suicide differ by sex and age of the bereaved offspring. External causes of death refer to deaths where the cause is external to the body, such as accidents, suicide and homicide, and do not include death due to illness.

2. Methods

2.1. Data sources

We retrieved individual data from three Norwegian longitudinal registers and merged them by means of the personal identification number. Firstly, we retrieved data from the Central Population Register, which has been computerized since 1964 and contains demographic data and a personal identifier for all individuals residing in Norway, as well as their links to legal parents (biological parents and adoptive parents). These links were utilized in order to identify the mother and father of individuals in the register. Secondly, we used the Cause of Death Register, which has been computerized since 1969 and contains the cause and date of all deaths in Norway coded according to ICD-8 (International Classification of Diseases, Eight Revision) from 1969 to 1985, ICD-9 from 1986 to 1995 and ICD-10 from 1996 to 2012 (Statistics Norway, 2012). Finally, we used Statistics Norway's Events Database (the so-called FD-Trygd database, available since 1992), which contains demographic and socioeconomic data, such as information concerning marital status, education and income.

2.2. Study design and population

This study is based on the national cohort of all individuals who experienced parental death due to external causes (E800-E999 in ICD-8 and 9, V01-Y89 in ICD-10). External causes of death include suicide (ICD-8 and ICD-9: E95, ICD-10: X60-X84 and Y870), transport accidents, including land, water and air transport methods (ICD-8 and ICD-9: E80-E84 and E920, ICD-10: V01-V99), and 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). In this bereaved cohort, we identified the cases who died from suicide at an age of 12–65 years old between 1992 and 2012 from the Cause of Death Register by using codes E95 (ICD-8 and ICD-9), X60-X84 and Y870 (ICD-10). A total of 375 suicide cases were retrieved. A nested-case control design (Clayton and Hills, 1993) was applied to randomly select 20 live controls from the bereaved cohort for each suicide case, resulting in 7500 matched controls. Controls were matched for age, gender and the date of suicide.

2.3. Variables

Variables under study include the interpersonal factors marital status, marital stability and residence stability, the intrapersonal factors ethnicity, education, residence centrality and income, and the bereavement-related factors cause of parental death, gender of deceased

and age at bereavement. Marital status, marital stability, education and income were derived from the Statistics Norway's Events Database, while residence stability, ethnicity and residence centrality were derived from the Central Population Register. All bereavement-related factors were derived from the Cause of Death Register.

2.3.1. Interpersonal factors

Marital status at suicide or matching was classified as a) married, b) unmarried, c) separated, d) divorced, e) widowed and f) missing. *Marital stability* refers to the number of changes in marital status and was classified as a) no change in status, b) one change in status and c) two or more changes in status. *Residence stability* refers to the number of changes in residence address and was classified as a) no change in residence, b) one change in residence, and c) two or more changes in residence.

2.3.2. Intrapersonal factors

Ethnicity was classified as a) native Norwegian (born in Norway with two Norwegian-born parents), and b) persons with immigration background (born in Norway with one or two foreign-born parents, immigrants and foreign-born Norwegians). *Education* at time of suicide or matching was classified as a) high (bachelor, master and doctoral degree), b) intermediate (upper secondary and post-secondary non-tertiary education), and c) low (no education, preschool, primary and lower secondary education, missing). *Residence centrality* at suicide or matching is based on Statistics Norway's centrality classification of municipalities (Statistics Norway, 2016), where municipalities are classified according to travel time to populated areas of different sizes, and was classified as a) least central, b) less central, c) somewhat central, and d) highly central. *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) missing. Information concerning income was based on registered status the year before the year of suicide or matching. Income data is only available from 1993, so people with a suicide or matching date before 1994 make up the majority of the missing category.

2.3.3. Bereavement-related factors

We classified *cause of parental death* as a) suicide, b) transport accident, and c) other external causes. *Gender of deceased parent* was classified into a) father deceased, b) mother deceased, and c) both parents deceased. Subjects were classified according to their *age at bereavement* into: a) up to 12 years, b) 13–24 years, c) 25–44 years, and d) 45–65 years. If both parents died at separate times or from different causes of death, age at bereavement and cause of death were classified according to the parent who died first.

2.4. Statistical analyses

All analyses were conducted using IBM SPSS Statistics, version 22 (IBMCORP, 2013). The outcome variable was completed suicide, and suicide risk was estimated by a conditional logistic regression analysis (Collett, 1991). Odds ratios (ORs) and 95% confidence intervals (95% CI) were estimated, and the Wald test was used to examine whether the odds ratios were significantly different from the reference. Univariate analyses yielded crude ORs adjusted for age, gender and calendar time through matching of cases and controls. A multivariate analysis yielded adjusted ORs further adjusted for all the variables in the study. Interactions between variables of study with sex and age were assessed with the log likelihood ratio test based on results from the multivariate analysis. Lastly, we assessed the interaction between marital status and education and the interaction between marital status and income, with marital status reclassified as a) married, b) single (unmarried, separated, divorced or widowed), and c) missing. The reference category was generally the value expected to be associated with the most favourable outcome (Gravseth et al., 2010). The study was approved by

Table 1
Distribution (%) of the study variable categories among suicide cases and matched controls.

Variable	All subjects		Daughters		Sons	
	Suicide cases (N = 375)	Controls (N = 7500)	Suicide cases (N = 112)	Controls (N = 2240)	Suicide cases (N = 263)	Controls (N = 5260)
Interpersonal variables						
<i>Marital status</i>						
Married	72 (19.2)	3219 (42.8)	24 (21.4)	1080 (48.2)	48 (18.3)	2139 (40.6)
Unmarried	211 (56.3)	3342 (44.6)	56 (50.0)	809 (36.1)	155 (58.9)	2533 (48.2)
Separated	19 (5.1)	149 (2.0)	5 (4.5)	54 (2.4)	14 (5.3)	95 (1.8)
Divorced	65 (17.3)	704 (9.4)	25 (22.3)	254 (11.4)	40 (15.2)	450 (8.6)
Widowed	8 (2.1)	82 (1.1)	2 (1.8)	43 (1.9)	6 (2.3)	39 (0.7)
Missing	0 (0)	4 (0.1)	0 (0)	0 (0)	0 (0)	4 (0.1)
<i>Marital stability</i>						
No change in marital status	257 (68.5)	5457 (72.8)	75 (67.0)	1543 (68.9)	182 (69.2)	3914 (74.4)
One change in marital status	55 (14.7)	1284 (17.1)	14 (12.5)	457 (20.4)	41 (15.6)	827 (15.7)
Two or more changes in marital status	63 (16.8)	759 (10.1)	23 (20.5)	240 (10.7)	40 (15.2)	519 (9.9)
<i>Residence stability</i>						
No change in residence	215 (57.3)	4993 (66.6)	62 (55.4)	1465 (65.4)	153 (58.2)	3528 (67.1)
One change in residence	65 (17.4)	1141 (15.2)	22 (19.6)	373 (16.7)	43 (16.3)	768 (14.6)
Two or more changes in residence	95 (25.3)	1366 (18.2)	28 (25.0)	402 (17.9)	67 (25.5)	964 (18.3)
Intrapersonal variables						
<i>Income</i>						
> 400 001 NOK	50 (13.3)	1693 (22.6)	6 (5.4)	277 (12.4)	44 (16.7)	1416 (26.9)
300 001 – 400 000 NOK	40 (10.7)	1241 (16.6)	11 (9.8)	346 (15.4)	29 (11.0)	895 (17.0)
200 001 – 300 000 NOK	76 (20.3)	1731 (23.1)	27 (24.1)	601 (26.8)	49 (18.6)	1130 (21.5)
100 001 – 200 000 NOK	122 (32.5)	1420 (18.9)	45 (40.2)	589 (26.3)	77 (29.3)	831 (15.8)
< 100 000 NOK	62 (16.5)	873 (11.6)	16 (14.3)	278 (12.4)	46 (17.5)	595 (11.3)
Missing*	25 (6.7)	542 (7.2)	7 (6.2)	149 (6.7)	18 (6.9)	393 (7.5)
<i>Education</i>						
High	60 (16.0)	1833 (24.4)	28 (25.0)	634 (28.3)	32 (12.2)	1199 (22.8)
Intermediate	160 (42.7)	3390 (45.2)	49 (43.7)	951 (42.5)	111 (42.2)	2439 (46.4)
Low	155 (41.3)	2277 (30.4)	35 (31.3)	655 (29.2)	120 (45.6)	1622 (30.8)
<i>Ethnicity</i>						
Native Norwegian	343 (91.5)	7073 (94.3)	103 (92.0)	2130 (95.1)	240 (91.3)	4943 (94.0)
Persons with immigration background	32 (8.5)	427 (5.7)	9 (8.0)	110 (4.9)	23 (8.7)	317 (6.0)
<i>Residence centrality</i>						
Least central	27 (7.2)	827 (11.1)	3 (2.7)	228 (10.2)	24 (9.1)	599 (11.4)
Less central	35 (9.3)	513 (6.8)	12 (10.7)	144 (6.4)	23 (8.7)	369 (7.0)
Somewhat central	76 (20.3)	1255 (16.7)	19 (17.0)	359 (16.0)	57 (21.7)	896 (17.0)
Highly central	237 (63.2)	4905 (65.4)	78 (69.6)	1509 (67.4)	159 (60.5)	3396 (64.6)
Bereavement-related variables						
<i>Gender of deceased</i>						
Father deceased	256 (68.3)	5402 (72.0)	78 (69.6)	1618 (72.2)	178 (67.7)	3784 (71.9)
Mother deceased	107 (28.5)	1966 (26.2)	32 (28.6)	579 (25.9)	75 (28.5)	1387 (26.4)
Both parents deceased	12 (3.2)	132 (1.8)	2 (1.8)	43 (1.9)	10 (3.8)	89 (1.7)
<i>Cause of death</i>						
Other cause	138 (36.8)	3522 (47.0)	36 (32.1)	1065 (47.5)	102 (38.8)	2457 (46.7)
Transport accident	67 (17.9)	1827 (24.3)	20 (17.9)	573 (25.6)	47 (17.9)	1254 (23.8)
Suicide	170 (45.3)	2151 (28.7)	56 (50.0)	602 (26.9)	114 (43.3)	1549 (29.5)
<i>Age at bereavement</i>						
0–12 years old	71 (18.9)	1569 (20.9)	18 (16.1)	430 (19.2)	53 (20.2)	1139 (21.7)
13–24 years old	132 (35.2)	2310 (30.8)	41 (36.6)	650 (29.0)	91 (34.6)	1660 (31.6)
25–44 years old	139 (37.1)	2628 (35.0)	40 (35.7)	837 (37.4)	99 (37.6)	1791 (34.0)
45–65 years old	33 (8.8)	993 (13.3)	13 (11.6)	323 (14.4)	20 (7.6)	670 (12.7)

* Income data is only available from 1993 and is based on registered status the year before the year of suicide or matching, so people with a suicide or matching date before 1994 make up the majority of the missing category (93%).

the Regional Ethics Committee South East Norway and owners of the relevant registers.

3. Results

In our cohort of offspring who were bereaved by parental death from external causes, 375 died by suicide at an age of 12–65 years, including 263 (70.1%) males and 112 (29.9%) females. The mean age at suicide or matching was 40.7 years (SD = 12.6) for the total, 41.6 (SD = 12.2) for females and 40.3 (SD = 12.7) for males. Table 1 shows the distribution of the study variable categories among the suicide cases and their comparison subjects. Compared to bereaved offspring in the control group, bereaved offspring who died by suicide were less likely

to be married, have no change in marital status and residence or have a high income and education. Bereaved offspring who died by suicide were also more likely to have experienced parental suicide or the death of both parents.

3.1. Risk factors for suicide

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. Overall, the odds ratios were only minimally altered after adjusting for all variables in the full model. Those who were unmarried, divorced, widowed and especially separated at the time of suicide or matching had a

Table 2
Conditional logistic regression analyses indicating suicide risk for all subjects and daughters and sons separately.

Variable	Crude OR ^a	Adjusted OR ^b			Interaction with gender	
	All subjects	All subjects	Daughters	Sons	χ ²	p
Interpersonal variables						
<i>Marital status</i>						
Married	1	1	1	1	2.54	0.64
Unmarried	3.63 (2.66–4.95) ^{***}	3.31 (2.31–4.74) ^{***}	4.35 (2.30–8.21) ^{***}	2.95 (1.90–4.58) ^{***}		
Separated	5.81 (3.42–9.88) ^{***}	3.93 (2.20–7.04) ^{***}	3.92 (1.23–12.46) [*]	4.00 (2.01–7.94) ^{***}		
Divorced	4.05 (2.87–5.73) ^{***}	2.54 (1.66–3.89) ^{***}	3.93 (1.80–8.62) ^{***}	2.30 (1.37–3.85) ^{**}		
Widowed	4.15 (1.92–9.00) ^{***}	3.67 (1.60–8.39) ^{**}	3.82 (0.77–19.09)	4.19 (1.55–11.32) ^{**}		
Missing	–	–	–	–		
<i>Marital stability</i>						
No change in marital status	1	1	1	1	3.42	0.18
One change in marital status	0.94 (0.69–1.28)	1.17 (0.76–1.82)	0.69 (0.29–1.62)	1.45 (0.87–2.41)		
Two or more changes in marital status	1.85 (1.36–2.50) ^{***}	1.77 (1.10–2.84) [*]	1.61 (0.68–3.78)	1.67 (0.94–2.96)		
<i>Residence stability</i>						
No change in residence	1	1	1	1	0.25	0.88
One change in residence	1.43 (1.06–1.92) [*]	1.28 (0.94–1.73)	1.39 (0.80–2.42)	1.25 (0.86–1.81)		
Two or more changes in residence	1.87 (1.41–2.49) ^{***}	1.56 (1.16–2.10) ^{**}	1.50 (0.85–2.65)	1.64 (1.16–2.32) ^{**}		
Intrapersonal variables						
<i>Income</i>						
> 400 001 NOK	1	1	1	1	4.78	0.44
300 001 – 400 000 NOK	1.25 (0.81–1.92)	1.04 (0.67–1.61)	1.88 (0.65–5.38)	0.92 (0.56–1.51)		
200 001 – 300 000 NOK	1.98 (1.35–2.92) ^{***}	1.45 (0.97–2.16)	3.26 (1.21–8.81) [†]	1.22 (0.78–1.93)		
100 001 – 200 000 NOK	4.50 (3.09–6.57) ^{***}	2.97 (1.99–4.41) ^{***}	7.64 (2.76–21.16) ^{***}	2.45 (1.56–3.84) ^{***}		
< 100 000 NOK	4.36 (2.80–6.79) ^{***}	2.93 (1.85–4.63) ^{***}	6.30 (2.02–19.60) ^{**}	2.70 (1.61–4.53) ^{***}		
Missing	–	–	–	–		
<i>Education</i>						
High	1	1	1	1	10.29	0.006
Intermediate	1.47 (1.08–1.99) [*]	1.36 (0.99–1.88)	0.98 (0.58–1.67)	1.65 (1.09–2.50) [*]		
Low	2.20 (1.61–3.01) ^{***}	1.60 (1.15–2.23) ^{**}	0.75 (0.42–1.32)	2.29 (1.49–3.51) ^{***}		
<i>Ethnicity</i>						
Native Norwegian	1	1	1	1	0.27	0.60
Persons with immigration background	1.55 (1.06–2.26) [*]	1.51 (1.02–2.25) [*]	1.80 (0.83–3.92)	1.41 (0.89–2.25)		
<i>Residence centrality</i>						
Least central	1	1	1	1	5.53	0.14
Less central	2.10 (1.25–3.51) ^{**}	2.43 (1.43–4.12) ^{***}	8.32 (2.25–30.83) ^{**}	1.75 (0.96–3.19)		
Somewhat central	1.86 (1.19–2.92) ^{**}	1.96 (1.24–3.11) ^{**}	5.26 (1.51–18.29) ^{**}	1.60 (0.97–2.64)		
Highly central	1.48 (0.99–2.23)	1.51 (0.99–2.29)	3.90 (1.20–12.69) [*]	1.20 (0.76–1.89)		
Bereavement-related variables						
<i>Gender of deceased</i>						
Father deceased	1	1	1	1	1.73	0.42
Mother deceased	1.15 (0.91–1.46)	1.13 (0.89–1.45)	0.92 (0.58–1.45)	1.22 (0.91–1.63)		
Both parents deceased	1.92 (1.05–3.51) [*]	2.49 (1.33–4.68) ^{**}	1.44 (0.33–6.41)	2.99 (1.47–6.06) ^{**}		
<i>Cause of death</i>						
Other cause	1	1	1	1	2.57	0.28
Transport accident	0.97 (0.72–1.31)	0.94 (0.69–1.29)	1.00 (0.55–1.83)	0.89 (0.62–1.30)		
Suicide	2.13 (1.67–2.71) ^{***}	1.99 (1.55–2.56) ^{***}	2.72 (1.67–4.43) ^{***}	1.74 (1.29–2.34) ^{***}		
<i>Age at bereavement</i>						
0–12 years old	1	1	1	1	1.83	0.61
13–24 years old	1.24 (0.91–1.69)	1.13 (0.82–1.56)	1.15 (0.62–2.14)	1.07 (0.73–1.57)		
25–44 years old	1.04 (0.72–1.51)	1.03 (0.70–1.52)	0.91 (0.43–1.92)	1.05 (0.66–1.66)		
45–65 years old	0.55 (0.32–0.95) [*]	0.68 (0.38–1.22)	0.91 (0.32–2.64)	0.57 (0.28–1.16)		

Risk is given in odds ratio with 95% confidence intervals in parenthesis.

^a The ORs derived from this model were adjusted for age, gender and calendar time through matching.

^b The ORs derived from this model were further adjusted for all the variables in the study.

* p < .05.

** p < .01.

*** p < .001.

higher suicide risk than those who were married. A history of two or more changes in marital status increased suicide risk compared to one or no change in marital status. Residence instability, especially changing residence address more than once, was associated with an increased suicide risk in offspring. In the multivariate analysis, having an annual income of less than 200,000 NOK significantly increased suicide risk compared to an income of more than 400,000 NOK. Similarly, a low education level increased suicide risk in the multivariate analysis compared to having a high education level, and people with an immigration background had an increased suicide risk compared to native Norwegians. Rural living in the least central municipalities was protective compared to residing in medium central municipalities, but the

risk was not significantly increased for highly central municipalities. Losing both parents increased suicide risk compared to losing one parent, but there was no significant difference between losing a mother and a father. Bereavement due to suicide increased offspring's suicide risk more than loss due to transport accidents or other external causes of death. Lastly, there were no differences in suicide risk depending on the offspring's age at bereavement.

3.2. Gender and age differences in risk factors

There were no significant gender differences in suicide risks associated with marital status, marital stability, residence stability, income,

Table 3

Conditional logistic regression analyses indicating suicide risk for offspring aged 12–29 years (93 cases, 1860 controls) and 30–65 years (282 cases, 5640 controls) separately.

Variable	Adjusted OR		Interaction with age group	
	12–29 years	30–65 years	χ^2	p
Interpersonal factors				
<i>Marital stability</i>				
No change in marital status	1		8.75	0.013
One change in marital status	7.34 (2.31–23.31) ^{***}	0.99 (0.62–1.60)		
Two or more changes in marital status	1.39 (0.28–6.97)	1.65 (0.99–2.75)		
<i>Residence stability</i>				
No change in residence	1		3.17	0.21
One change in residence	1.85 (1.06–3.21) [*]	1.08 (0.74–1.57)		
Two or more changes in residence	1.44 (0.82–2.56)	1.57 (1.11–2.23) [†]		
Intrapersonal factors				
<i>Income</i>				
> 400 001 NOK	1	1	6.19	0.29
300 001 – 400 000 NOK	0.58 (0.13–2.55)	1.13 (0.71–1.78)		
200 001 – 300 000 NOK	0.51 (0.15–1.79)	1.77 (1.16–2.69) ^{**}		
100 001 – 200 000 NOK	1.36 (0.42–4.39)	3.54 (2.31–5.42) ^{***}		
< 100 000 NOK	1.95 (0.59–6.44)	2.75 (1.57–4.82) ^{***}		
Missing	–	–		
<i>Education</i>				
High	1	1	14.28	0.0008
Intermediate	2.19 (0.93–5.15)	1.24 (0.87–1.75)		
Low	4.96 (2.16–11.36) ^{***}	1.19 (0.81–1.73)		
<i>Ethnicity</i>				
Native Norwegian	1	1	0.41	0.52
Persons with immigration background	1.63 (0.83–3.19)	1.23 (0.72–2.10)		
<i>Residence centrality</i>				
Least central	1	1	1.46	0.69
Less central	2.45 (0.76–7.91)	2.36 (1.30–4.27) ^{**}		
Somewhat central	1.78 (0.63–5.04)	2.07 (1.24–3.46) ^{**}		
Highly central	1.80 (0.70–4.63)	1.42 (0.89–2.27)		
Bereavement-related factors				
<i>Gender of deceased</i>				
Father deceased	1	1	1.64	0.44
Mother deceased	0.84 (0.48–1.46)	1.25 (0.95–1.64)		
Both parents deceased	2.46 (0.54–11.30)	2.63 (1.31–5.31) [*]		
<i>Cause of death</i>				
Other cause	1	1	1.33	0.52
Transport accident	0.74 (0.37–1.47)	1.01 (0.71–1.43)		
Suicide	2.19 (1.30–3.66) ^{**}	1.98 (1.48–2.65) ^{***}		
<i>Age at bereavement</i>				
0–12 years old	1	1	1.69	0.43
13–24 years old	1.08 (0.68–1.73)	1.09 (0.69–1.74)		
25–44 years old	1.82 (0.71–4.65)	0.94 (0.58–1.53)		
45–65 years old		0.61 (0.32–1.18)		

Risk is given in odds ratio with 95% confidence intervals in parenthesis.

Marital status was excluded from the table since low N made the results unreliable.

The ORs derived from this model were adjusted for all the variables in the study.

* p < .05.

** p < .01.

*** p < .001.

ethnicity, residence centrality, gender of the deceased, cause of death or age at bereavement, tested through the log likelihood ratio test. There was, however, a significant gender difference in the influence of education in that intermediate and low education levels raised suicide risk moderately more in sons than in daughters (Table 2).

Table 3 depicts separate adjusted analyses for offspring above and below 30 years of age and the associated age interaction test. No age differences were evident for the effects of residence stability, income, ethnicity, residence centrality, gender of the deceased, cause of death or age at bereavement. However, there was a significant age difference in the risks associated with marital stability in that younger offspring with an unstable marital status displayed a particularly high suicide risk. Additionally, a significant age difference was evident for education: Education had a stronger effect on suicide risk in younger bereaved offspring compared to older bereaved offspring. Because of the low number of younger people who were either separated, divorced or widowed at the time of suicide or matching, the test of age interaction with marital status was not able to produce reliable information, and

the result is therefore not shown in the table.

3.3. Interaction between SES and marital status

Fig. 1 depicts the odds ratios for suicide associated with income and education for bereaved offspring who are married or registered as single. The increased risks of suicide associated with low income and education were confined only to bereaved offspring who were single, but the difference did not reach significance in the multivariate model (marriage interaction test: $p = 0.23$ for education, and $p = .26$ for income).

4. Discussion

The present study has shown that several interpersonal, intrapersonal and bereavement-related risk factors significantly influenced suicide risk in offspring bereaved by parental death from external causes. Being unmarried, separated, divorced or widowed, and having

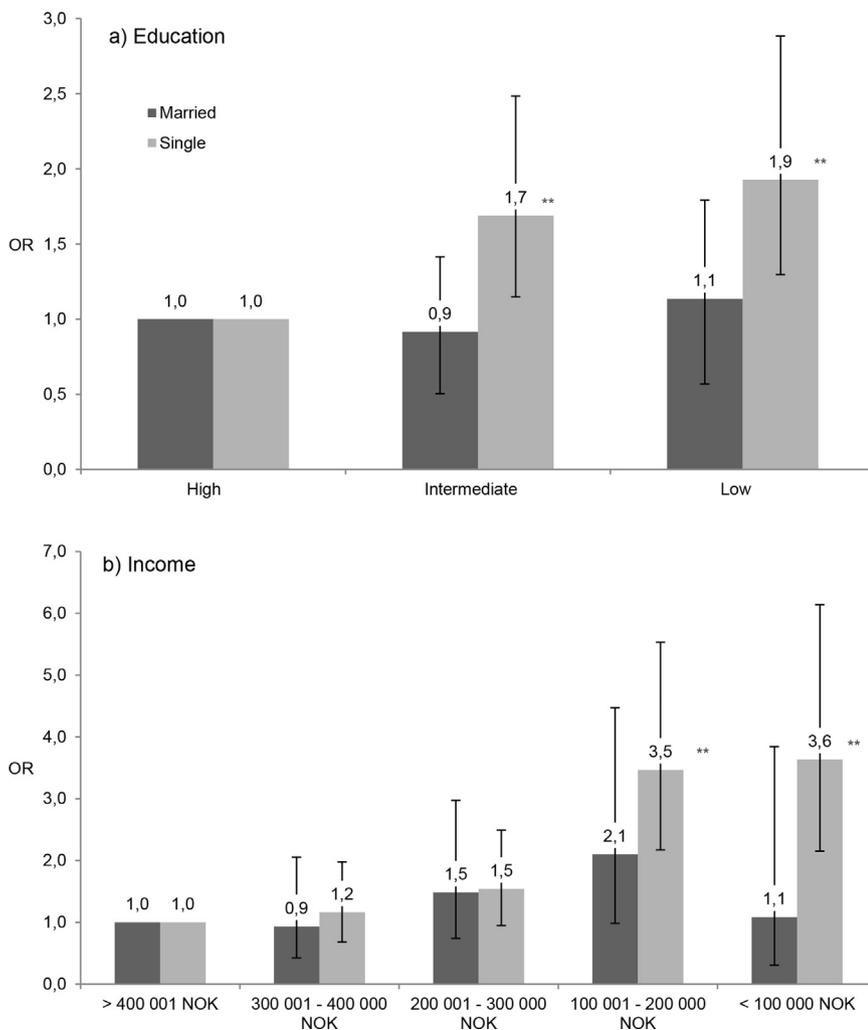


Fig. 1. Odds ratios for suicide associated with a) education and b) income for bereaved offspring who are married or single (unmarried, separated, divorced or widowed). Error bars indicate 95 % confidence intervals. The missing categories were excluded from the figure since low N made the results unreliable. The ORs derived from these models were adjusted for all the variables in the study * $p < .05$, ** $p < .01$, *** $p < .001$.

an unstable marital status and residence increased suicide risk. Low income, low education, having an immigration background, and living in medium central municipalities also increased suicide risk. Lastly, losing both parents and losing a parent to suicide increased the offspring's suicide risk. There were mostly insignificant differences between genders and age groups.

4.1. Interpersonal factors

Being single, either because of never marrying or from losing a spouse to separation, divorce or death, constituted the highest risk for suicide in the present study. The social support implied in being married seems to constitute a powerful protection against suicide in this vulnerable group, as in the general population (Kposowa, 2000). An individual's marital status can act either as a resource during difficult times, or as a situational demand, source of conflict or lack of support. At the same time, separation, divorce and widowhood will often induce a range of legal challenges, economic decline and a potential extra caregiver burden (Stroebe et al., 2006). In this study, we did not, however, perform a closer analysis of the temporal relation between bereavement and loss of a partner by separation, divorce or widowhood, and this may be an aim for future studies.

All the interpersonal factors investigated in the present study significantly influenced bereaved offspring's suicide risk, indicating the importance of social support. These findings are in line with previous research reporting the negative effects of low social support on bereavement outcome (Burke and Neimeyer, 2012; Pitman et al., 2016; van der Houwen et al., 2010), as well as bereaved family members' own

accounts of the importance of social networks (Dyregrov, 2002). Likewise, improved social support in the form of an augmented parent-child relationship has been found to mediate some of the effect of a successful bereavement intervention program (Tein et al., 2006). There seems to be a dose-response relationship between suicide risk and life stability, suggesting that a gradually increased exposure to low life stability and social support progressively increases suicide risk. The increased risk is especially marked in younger people with marital instability, probably because this instability early in life suggests a person with a particularly unstable life with low family cohesion and social support.

Marital instability, residence instability and being single may reduce social support, destabilize family cohesion and increase isolation. In addition to the loss of a parent, losing a partner and the discontinuation of social and personal life following marital and residence instability may feel as an extra loss and even a traumatic event, resulting in a cumulative effect. Additionally, marital instability and residence instability could be the effect of psychiatric disorders, given that mentally distressed individuals have a higher likelihood of divorce (Idstad et al., 2015). The increased suicide risk associated with life instability in the present study may hence be caused by both low social support and psychiatric disorders.

4.2. Intrapersonal factors

Low income and education are risk factors for suicide in the general population as well as in the present study (Qin et al., 2003), potentially because having low SES may entail reduced skills, life competence and mental health (Kessler et al., 1994), which reduces capacities for coping

and recovery. Moreover, the stressors indirectly associated with bereavement, including economic decline, legal problems, and the caregiver burden of the surviving parent (Stroebe et al., 2006), may exacerbate these challenges. This increased risk associated with low income and education is mostly apparent for people who are single, again signifying the importance of social support. It is, however, unclear whether this could be associated with the relatively increased financial security accompanying marriage (Zagorsky, 2005) or with a buffering function of social support against the hardships entailed in a low SES.

The increased suicide risk in people with an immigration background compared to people born in Norway to Norwegian parents can be a result of the lower social support and smaller networks reported by immigrants compared to natives (Salinero-Fort et al., 2011). For offspring with an immigration background, sudden parental bereavement can furthermore entail a great loss of family ties and an even further weakening of personal network support. Additionally, immigrant populations are less inclined to seek help from health care services and may experience barriers in accessing mental health treatment (Straiton et al., 2014). In accordance with findings from the Norwegian youth population (Mehlum et al., 1999), suicide risk was significantly increased in medium central municipalities compared to the least central municipalities. The reasons for this finding are unclear, and might be related to differences in social network, community culture or availability of health care services and follow-up for bereaved family and friends (Dyregrov, 2002). Future research may aim to replicate and explain this finding.

Evidently, being single (Kposowa, 2000), having an unstable residence (Qin et al., 2009), low SES (Qin et al., 2003), immigration background (Di Thiene et al., 2015), and living in medium central municipalities (Mehlum et al., 1999) are important generic risk factors for suicide in the general population. The present study demonstrates that these factors also serve as suicide risk factors for offspring bereaved by parental death from external causes. Previous and current psychiatric problems are also both generic and specific risk factors and have been reported to predict suicide and suicidal ideation in bereaved first-degree relatives (de Groot and Kollen, 2013; Runeson and Asberg, 2003). We were, however, unable to ascertain the relative influence of mental health issues in the present study due to limited access to such data.

4.3. Bereavement-related factors

In accordance with previous studies (Garssen et al., 2011), losing both parents and losing a parent to suicide has substantial effects on increasing the risk of suicide in the bereaved offspring. Previous findings have suggested a dose-response relationship between the severity of a traumatic experience and the risk of suicidal behaviour (Molnar et al., 2001), and it seems that offspring's suicide risk increased with increased severity of the bereavement in the present study. Suicide is caused by an intentional act of self-harm and thus often leads to a more complex loss experience (Sveen and Walby, 2008) in addition to the stigma still attached to this cause of death. The loss of both parents will probably be perceived by most offspring as more severe and the bereavement will often lead to more extensive changes in care-taking routines and residence. As a complimentary explanation of the increased suicide risk in offspring bereaved by parental suicide, suicide tends to cluster in families because of possible genetic vulnerability linked to suicidal behaviour and mental health problems (Tidemalm et al., 2011).

4.4. Strengths and limitations

The present study is, to our knowledge, the first study that assesses the relative influence of a range of personal and bereavement-related factors on risk of suicide in a cohort of people bereaved by parental

death from external causes. The utilization of national longitudinal registers enables the inclusion of a large number of subjects who have experienced parental death from external causes. This yields relatively greater statistical power in comparison with other studies investigating risk and protective factors in bereaved family and friends (Stroebe et al., 2006). Furthermore, the use of national registers allows us to follow subjects for an entire lifespan and to link offspring and parents. Data in Norwegian registers are collected systematically and uniformly and cover all suicides in the entire population, reducing the risk of biases. This increases the generalizability of findings from this study.

The reported findings are also subject to limitations. Some variables relevant to bereavement outcome, such as individual appraisal of the bereavement, coping mechanisms and the quality of the parent-offspring relationship (Andriessen et al., 2016; Stroebe et al., 2006) are impossible to examine by utilizing population registers. In addition, there are several other risk factors that potentially influence suicide risk, such as employment status and number of close friends, which are not investigated in the present study because investigating all potential variables combined in one study is impossible (Stroebe et al., 2006). Since socioeconomic and demographic data are available since 1992, our data cover a relatively long time period, but do not enable the measurement of marital stability and residence stability across the entire lifespan for older individuals. Lastly, the present study is unable to draw conclusions concerning causality, and future research should aim to study the mediating mechanisms between risk factors and suicidality.

4.5. Conclusions and implications

In conclusion, bereaved offspring who are single, have less stable residence and marital status, have low SES or an immigration background, live in medium central areas, and who have experienced very severe bereavement are at increased risk of suicide. Low social support is an especially prominent risk factor for suicide, and other parameters suggesting low support and stability in addition to the variables investigated in the present study, such as few close friends, expressed loneliness, strained family relations, limited activities with social contact, or unstable employment may also be risk factors for suicide.

Although bereaved family and friends have a higher likelihood of suicide compared to non-bereaved peers (Agerbo et al., 2002; Gravseth et al., 2010; Guldin et al., 2015; Niederkrotenthaler et al., 2012; Wilcox et al., 2010), especially when subject to the risk factors outlined in the present study, we must remember that the majority of bereaved people will return to a normal functioning after a period of grief. Primary healthcare professionals should irrespectively be aware of the additional risk posed by the risk factors identified in the present study, and should incorporate this knowledge into existing practice and risk assessment in order to identify individuals at risk. The school sector and community gatekeepers also have important roles in identifying people at risk of mental ill health and suicidal behaviour and would benefit from knowledge of central risk factors. Furthermore, mental healthcare professionals should rely on information about potent risk factors in order to effectively target bereaved family and friends at particular risk of suicide in prevention and intervention programs. Primary healthcare can additionally perform first-line prevention and intervention by encouraging bereaved people to contact family, friends or survivor organizations in order to increase social support. Survivor organizations fronting a "postvention as prevention" approach need to be aware of important risk factors on a population level, given that their knowledge of risk factors is normally based on specific cases and anecdotes. The finding that limited social support is a strong risk factor for suicide in this population lends support to the efficacy and further development of peer-to-peer help such as bereavement support groups provided by survivor organizations. Lastly, knowledge held by policy makers about the increased risk posed by relevant interpersonal, intrapersonal and bereavement-related factors can improve procedures for follow-up after bereavement, especially since bereaved family members frequently

express that they have received inadequate help from public health services in Norway (Dyregrov, 2002). Ideal follow-up for bereaved families in the future would include a specific focus on mobilizing social support in all its forms.

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