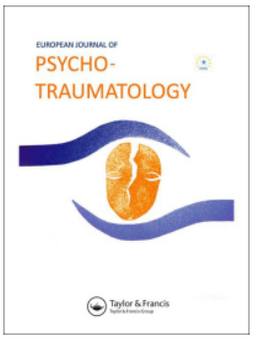

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BASIC RESEARCH ARTICLE

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Bereavement and maternal mental disorders during the perinatal period: a nationwide register-based study in Sweden

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ABSTRACT

Background: Perinatal mental disorders are common, yet few robust risk factors are known. Stressful life events such as loss of a close family member due to death could serve as potential clinical predictors for which mothers develop perinatal mental disorders. This study investigated the association between bereavement and the risk of first-onset perinatal mental disorders.

Method: This nationwide register-based study included 1,986,490 pregnancies in Sweden (1,097,126 mothers). The exposure was death of a family member (sibling, parent, partner or child) occurring any time before pregnancy and during the perinatal period, treated as a time-varying variable (number exposed = 276,252). The outcome consisted of first-onset mental disorders diagnosed during the pregnancy and the year after birth were identified from registers. Hazard ratios (HRs) for any mental disorder and specific disorders were estimated using Cox proportional hazards regression.

Results: Loss of a family member at any time before or during the perinatal period was associated with an increased risk of any perinatal mental disorder (hazard ratio [95% confidence interval]: 1.44 [1.41, 1.48]), particularly if the loss occurred during the perinatal period (5.86 [5.62, 6.12]). The strongest associations were observed for postpartum mental disorders in relation to stillbirth (25.97 [24.60, 27.42]) or multiple losses during the perinatal period (16.92 [13.72, 20.86]). Family loss during the perinatal period was most strongly associated with stress-related disorders (16.90 [16.10, 17.75]), but also with depressive, anxiety, and psychotic disorders.

Conclusions: Loss of a family member was associated with increased risks of first-onset perinatal mental disorders, particularly if the loss occurred during the perinatal period. Bereaved women may benefit from enhanced monitoring and screening for mental disorders during the perinatal period.

Duelo y trastornos mentales maternos durante el período perinatal: un estudio nacional basado en registros en Suecia

Antecedentes: Los trastornos mentales perinatales son comunes, pero se conocen pocos factores de riesgo robustos. Eventos vitales estresantes, como la pérdida de un familiar cercano por fallecimiento, podrían servir como posibles predictores clínicos de que las madres desarrollen trastornos mentales perinatales. Este estudio investigó la asociación entre el duelo y el riesgo de primera aparición de trastornos mentales perinatales.

Método: Este estudio nacional basado en registros incluyó 1.986.490 embarazos en Suecia (1.097.126 madres). La exposición fue la muerte de un familiar (hermano, madre, padre, pareja o hijo) ocurrida en cualquier momento antes del embarazo y durante el período perinatal, considerada como una variable en el tiempo (número de madres expuestas = 276.252). El resultado consistió en la primera aparición de trastornos mentales diagnosticados durante el embarazo y el año posterior al nacimiento, identificados a partir de los registros. Los cocientes de riesgo (HR en su sigla en inglés) para cualquier trastorno mental y trastornos específicos se estimaron mediante la regresión de riesgos proporcionales de Cox.

Resultados: La pérdida de un familiar en cualquier momento antes o durante el período perinatal se asoció con un mayor riesgo de cualquier trastorno mental perinatal (cociente de riesgo [IC del 95%]: 1.44 [1.41, 1.48]), especialmente si la pérdida ocurrió durante el período perinatal (5.86 [5.62, 6.12]). Las asociaciones más fuertes se observaron para los trastornos mentales posparto en relación con la muerte fetal intrauterina (25.97 [24.60, 27.42]) o las

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Perinatal mental health; bereavement; family loss; registry; longitudinal

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Duelo; perinatal; pérdida; salud mental de la mujer; psicosis

HIGHLIGHTS

- Losing a family member during the perinatal period was a highly impactful risk factor for perinatal mental illness.
- Associations were found with every category of mental illness, including psychosis.
- Losing a child was a particularly strong risk factor, increasing the risk of mental illness for 5 years or longer after the loss.

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pérdidas múltiples durante el período perinatal (16.92 [13.72, 20.86]). La pérdida familiar durante el período perinatal se asoció con mayor intensidad con los trastornos relacionados con el estrés (16.90 [16.10, 17.75]), pero también con los trastornos depresivos, de ansiedad y psicóticos.
Conclusiones: La pérdida de un familiar se asoció con un mayor riesgo de primera aparición de trastornos mentales perinatales, especialmente si la pérdida ocurrió durante el período perinatal. Las mujeres en duelo podrían beneficiarse de un mejor seguimiento y detección de trastornos mentales durante el período perinatal.

1. Introduction

By latest global estimates, 15% of pregnant women experience major depression (Yin et al., 2021 Feb 1) and 21% are diagnosed with anxiety disorders (Fawcett et al., 2019). The incidence remains high in the first year after childbirth, as psychiatric admissions are five times higher postpartum than pre-pregnancy (Martin et al., 2016). There is general uncertainty around which factors contribute to the development of perinatal mental disorders. Their etiology is likely to involve complex interactions between environment, genetics, and sensitivity to the defining hormonal changes around pregnancy (Munk-Olsen & Agerbo, 2015). Stressful life events, like poverty, domestic violence, and death in the family are examples of risk factors that may trigger the onset of perinatal mental disorders (Howard & Khalifeh, 2020).

Death of a close family member can cause severe stress following grief and may have a profound impact on mental health (Rheingold et al., 2024), also for pregnant women (Howard & Khalifeh, 2020). Earlier studies regarding the association between bereavement and perinatal mental health have focused mainly on perinatal loss, i.e. miscarriage, stillbirth or neonatal loss. One study reported a nine-fold increased risks of clinical anxiety and depression symptoms in the first month after stillbirth (Hogue et al., 2015). Limited evidence also suggests that for more than half of women symptoms persist in the subclinical range four years and longer after the loss (Hogue et al., 2015; Cacciatore et al., 2013). In contrast, losing a parent in childhood was not found to be associated with any perinatal mental disorder (Meltzer-Brody et al., 2018). Thus in terms of bereavement, pregnancy loss is a well-documented predictor clinicians could potentially use to monitor perinatal psychopathology, which has otherwise proven challenging to predict.

It remains unknown how other characteristics of bereavement could affect perinatal mental health and whether they may be equally robust to be clinically useful. These characteristics include the relationship to the deceased (i.e. parent, sibling, partner or older child), how recent the loss was (including time prior to pregnancy), the nature of the death (natural vs. unnatural causes), and the number of accumulated losses (Stroebe et al., 2007; Valsamakis et al., 2019). A previous study analysed the association between bereavement the year before or during pregnancy and the risk of postpartum psychosis (Warselius et al., 2019), but so far there has been no comprehensive investigation of the full spectrum of perinatal mental disorders.

The current nationwide population-based cohort study investigated if the death of a family member was associated with an increased risk of first-onset mental disorders during the perinatal period. We investigated the associations between bereavement and the risk of the first-onset of any, and of common types of, mental disorders during pregnancy and up to one year postpartum. We also explored whether characteristics of the loss affected the association.

2. Methods

2.1. Study population and design

The Swedish Medical Birth Register was used to identify births in Sweden from 2001 to 2021. The register contains data on virtually all births in Sweden exceeding 22 weeks of gestation, from the first visit to prenatal care through delivery and neonatal care. Date of conception for each pregnancy was estimated by subtracting the length of gestation from the date of delivery.

Each resident in Sweden is assigned a unique personal identification number at birth or immigration, which can be used to link data across different registers. We followed all mothers from conception of her present pregnancy, 1 January 2001, or her immigration to Sweden, whichever came later, until the occurrence of outcomes, conception of a new pregnancy, one year after delivery, emigration, death, or 31 December 2022, whichever came first. This timeframe defined the follow-up period and approximates the working definition for perinatal period (O'Brien et al., 2023). Mothers who had received a psychiatric diagnosis before conception were excluded as our aim was to study first-onset mental disorder. This resulted in a total of 1,986,490 pregnancies of 1,097,126 mothers included in the analysis of any perinatal mental disorder. Follow-up analyses of specific disorders excluded only pregnancies with previous history of the corresponding disorder. The number

of excluded pregnancies and the final sample sizes for different analyses can be found in Supplementary Table 1.

The study was approved by the Swedish Ethical Review Authority (2018/1515-31 and 2021/03315).

2.2. Ascertainment of death of family member

We used the Multi-Generation Register to identify the mother's close family members, including parents, siblings, partners and children, including the one from the current or previous pregnancy (i.e. stillbirth after 22 weeks of pregnancy or neonatal death). Current/ex-partners were included if they were married or cohabiting with the mother up to a year before death. All losses that occurred at any time before or during follow-up were recorded. Data from biological parents is available for 100% of women born in Sweden and for 74% of foreign born women (Ekbom, 2011). The Causes of Death Register was used to provide information on the date of death and the underlying cause of death. Cause of death was further categorized as either unnatural (International Classification of Diseases [ICD]-10 codes R95 [sudden infant death], R96 [sudden death, cause unknown], R98 [unattended death], V01-Y98 [external causes of death]) or natural (remaining ICD-10 codes) (Hagatulah et al., 2024). Recency of loss was categorized as occurring during the perinatal period, as well as one, two, three, four, five, and six years or more prior to pregnancy. A cumulative count of deceased family members was calculated to indicate number of losses experienced any time before pregnancy and throughout the follow-up.

We treated loss as a time-varying exposure. Mothers who had not experienced family loss before conception of the present pregnancy but lost a close family member during the follow-up contributed person-time to the unexposed group until the loss, and to the exposed group afterwards. Mothers who had experienced loss before conception contributed only to the exposed group, whereas mothers who did not experience any loss before and throughout the follow-up contributed only to the unexposed group. In case of multiple losses before pregnancy, the latest loss was analysed except when counting number of losses.

2.3. Ascertainment of perinatal mental disorders

The Patient Register contains virtually all hospitalization records from 1987 and more than 80% of outpatient records from specialist care since 2001, including the diagnostic category assigned and the date of admission and discharge. First, we identified any mental disorder diagnosis from both the primary and secondary diagnoses received during follow-up (ICD-10 codes: F10-F99). Similarly, we identified diagnoses for major types of mental disorders, namely for depression (F32, F33, F53.0); anxiety (F40, F41); psychotic disorders (F20-F29, F53.1) including schizophrenia, puerperal and postpartum psychosis; and stress-related disorders (F43) including posttraumatic stress disorder. History of any or type-specific mental disorder (i.e. diagnoses recorded before conception) was also assessed for exclusion in corresponding analysis (Supplementary Table 1).

2.4. Covariates

A set of factors were considered as potential causes of both death in the family and risk of perinatal mental disorder. These consisted of age, highest education, annual personal income, country of birth, region of residence, calendar year of the index pregnancy, number of family members, and history of mental disorders in the family. Demographic information on mothers was collected using the Medical Birth Register (age, country of birth, region of residence at start of pregnancy) and the Longitudinal Integrated Database for Health Insurance and Labor Market Studies (educational level and personal income the year before pregnancy). Data on family size and history of mental disorders was collected using the Multi-Generation Register and the Patient Register. Additionally, we used information from the Medical Birth Register on maternal civil status, smoking status, BMI in early pregnancy, and diabetic and hypertensive disorders. Covariates were categorized as shown in Table 1.

2.5. Statistical analysis

The primary estimate of interest was the hazard ratios (HR) of mental disorders during the perinatal period according to any family loss before or during follow-up, analysed using Cox proportional hazards regression. The proportional hazards assumption was checked by plotting the scaled Schoenfeld residuals (Grambsch & Therneau, 1994). The results suggested no violation of the assumption. We adjusted all estimates for age, educational level, monthly income, country of birth, region of residence, calendar year of index pregnancy, number of family members, and family history of mental disorders. We also provided estimates when additionally adjusting characteristics assessed in early pregnancy, namely BMI, civil status, smoking status, and gestational diabetes and hypertension. Adjusting for these characteristics can increase the precision of estimates, but they could potentially also mediate the association with postpartum mental disorders. To shed light on the antepartum and postpartum mental disorders, an additional

Table 1. Sample characteristics of the cohort.

		Unexposed to family loss	Exposed to family loss
		(*N* = 1,710,221)	(*N* = 276,252)
Person-years contributed		2,931,944	470,154
		N (%)	*N* (%)
Any mental disorder in the perinatal period		35,469 (2.1%)	8,202 (3.0%)
Anxiety disorder		13,359 (0.8%)	2,380 (0.9%)
Depressive disorder		13,357 (0.8%)	2,659 (1.0%)
Psychotic disorder		742 (0.0%)	112 (0.0%)
Stress-related disorder		8,563 (0.5%)	3,358 (1.2%)
Mental disorders in the family		409,056 (23.9%)	111,813 (40.5%)
Mother's country of birth	Sweden	1,247,797 (73.0%)	251,725 (91.1%)
	Europe	141,537 (8.3%)	7,688 (2.8%)
	Other	320,881 (18.8%)	16,839 (6.1%)
	Missing	6 (0.0%)	0 (0.0%)
Region of residence	Southern Sweden	395,681 (23.1%)	61,503 (22.3%)
	Central Sweden	1,050,935 (61.5%)	167,463 (60.6%)
	Northern Sweden	263,480 (15.4%)	47,286 (17.1%)
	Missing	125 (0.0%)	0 (0.0%)
Completed years of education	Less than 9 years	46,840 (2.7%)	2,230 (0.8%)
	9–12 years	718,298 (42.0%)	138,123 (50.0%)
	More than 12 years	810,074 (47.4%)	132,940 (48.1%)
	Missing	135,009 (7.9%)	2,959 (1.1%)
Civil status[3]	In marriage or registered partnership	1,540,273 (90.1%)	247,638 (89.6%)
	Single or living with someone else	89,911 (5.3%)	14,267 (5.2%)
	Missing	80,037 (4.7%)	14,347 (5.2%)
Smoking before pregnancy	No smoking	1,427,622 (83.5%)	221,011 (80.0%)
	1–9 cigarettes per day	116,254 (6.8%)	19,945 (7.2%)
	10 + cigarettes per day	100,747 (5.9%)	23,042 (8.3%)
	Missing	65,598 (3.8%)	12,254 (4.4%)
Diabetes	None	1,672,899 (97.8%)	269,781 (97.7%)
	Gestational	27,680 (1.6%)	4,386 (1.6%)
	Pregestational	9,636 (0.6%)	2,085 (0.8%)
	Missing	6 (0.0%)	0 (0.0%)
Hypertension	None	1,625,577 (95.1%)	259,521 (93.9%)
	Pregestational	9,718 (0.6%)	2,602 (0.9%)
	Gestational	24,863 (1.5%)	4,719 (1.7%)
	Preeclampsia	50,057 (2.9%)	9,410 (3.4%)
	Missing	6 (0.0%)	0 (0.0%)
		Mean (SD)	Mean (SD)
Maternal age, years		30.7 (5.0)	32.6 (5.2)
	Missing	19 (0.0%)	8 (0.0%)
Annual personal income, euros		1,605.9 (2053.0)	1,665.3 (1989.7)
	Missing	78,670 (4.6%)	1,143 (0.4%)
Number of family members		3.5 (2.0)	3.5 (2.0)
BMI[2] during early pregnancy, kg/m^2		24.7 (4.6)	25.2 (4.9)
	Missing	134,225 (7.8%)	24,188 (8.8%)

Note. [1]SD = Standard deviation [2] BMI = Body mass index [3] Assessed at start of pregnancy.

analysis was conducted splitting the follow-up period into the antepartum and postpartum periods.

A series of secondary analyses were conducted by exploring various characteristics of loss, namely: (1) the recency of loss; (2) number of losses prior to pregnancy; (3) the nature of death (natural or unnatural death) of most recently deceased family member; and (4) the relationship with most recently deceased family member (i.e. parent, sibling, partner, child). To further analyse the role of loss occurring specifically during the perinatal period, we repeated the above analyses whenever possible, also differentiating stillbirth or neonatal death as exposure. We then performed analyses investigating how the recency of loss is associated with perinatal mental disorders according to the relationship with the deceased. Finally, we investigated associations with specific mental disorders, namely depression, anxiety, stress-related disorders, psychotic disorders, or other disorders. A false discovery rate correction was applied to analyses testing these five different outcomes (any mental disorder and four diagnostic categories) to control the familywise error rate.

All analyses were carried out in R version 4.3.1 (R Core Team, 2021) using the 'survival' package (Therneau, 2009). Multiple imputation was used to handle missing data using 5 imputed datasets as implemented in the R package 'Amelia' (Honaker et al., 2011). All analysis code can be found on https://osf.io/wa7mc/

3. Results

During the follow-up of 3,402,098 person-years, 276,252 (13.9%) mothers at an average age of 32.6 years at conception were exposed to a loss of family member before or during the perinatal period. Mothers exposed to a loss of family member were more likely to be born in Sweden compared to unexposed mothers (91.1% vs. 73.0% respectively), to have higher educational attainment (0.8% had less

than 9 years of education vs. 2.7%), and to smoke before pregnancy (20% vs. 16.5%; Table 1).

3.1. Overall family loss and the risk of any perinatal mental disorder

Death of a family member any time before or during the perinatal period was associated with a 44% increased risk of perinatal mental disorder after adjusting for confounders (HR [95% CI]: 1.44 [1.41, 1.48]; Table 2). The association remained similar after further adjustment for early pregnancy-related characteristics (1.41 [1.38, 1.45]). A stronger association was found for postpartum mental disorders (1.67 [1.62, 1.73]) compared to antepartum disorders (1.12 [1.08, 1.17]).

3.4. Characteristics of the loss and the risk of perinatal mental disorders

Compared to mothers who did not experience any loss, mothers who lost a family member during the perinatal period had an almost six times higher risk of perinatal mental disorders (HR [95% CI]: 5.86 [5.62, 6.12]; Figure 1). The effect size was much smaller for loss experienced up to a year before conception (1.36 [1.26, 1.47]; Figure 1). Being exposed to loss earlier than one year before conception was not associated with perinatal mental disorders. We observed a dose–response relationship between number of losses before or during the perinatal period and the outcome, with the highest risk observed for 4 or more losses (2.46 [1.70, 3.57]; Figure 1). The risk of perinatal mental disorder was comparable between loss of a family member due to natural or unnatural death. The association was stronger for loss of a child (6.73 [6.47, 7.00]; Figure 1), and loss of a partner (1.76 [1.50, 2.06]) than for loss of a parent (1.07 [1.03, 1.10]) or sibling (1.04 [0.99, 1.10]), the last of which was not statistically significant at the 5% level.

Table 2. Associations between family loss experienced before or during perinatal period and any perinatal mental disorder.

	Hazard ratio [95% Confidence interval]
Unadjusted association	1.58 [1.54, 1.62]
Adjustment for demographic variables[1]	1.59 [1.55, 1.63]
Adjustment for further confounding variables[2]	1.44 [1.41, 1.48]
Adjustment for early pregnancy characteristics[3]	1.41 [1.38, 1.45]
Association with mental disorders during antepartum period[4]	1.12 [1.08, 1.17]
Association with mental disorders during postpartum period[5]	1.67 [1.62, 1.73]

[1]Adjusted for maternal age, mother's country of birth, geographic area of residence, education, income, and calendar year of birth.
[2]Additionally adjusted for were number of family members before pregnancy and familial history of mental disorders.
[3]Additionally adjusted for mother's smoking status before pregnancy, civil status, body mass index during early pregnancy, diabetic and hypertensive disorders.
[4]Any mental disorders outcome restricted to only occur during antepartum period. Estimate adjusted for demographic and confounding variables.
[5]Any mental disorders outcome restricted to only occur during postpartum period. Estimate adjusted for demographic and confounding variables.

3.5. Loss within the perinatal period

When focusing on loss occurring in the perinatal period, we found that loss of an older child (HR [95% CI]: 13.57 [11.96, 15.40]); neonatal death (14.90 [13.06, 17.01]); multiple losses (16.92 [13.72, 20.86]) and stillbirth (25.97 [24.60, 27.41]) were associated with particularly high risks of perinatal mental disorders (Supplementary Figure 1). The association between any loss and mental disorders was stronger for postpartum than for antepartum mental disorders due to stillbirth/neonatal deaths (Supplementary Figure 2).

3.6. Recency of latest loss according to the relationship

Figure 2 presents the associations by timing of loss and the relationship to the deceased. The risk of perinatal mental disorders was increased following loss of any family member during the perinatal period. For loss occurring a year prior to conception, increased risk was noted when losing a current/ex-partner (HR [95% CI]: 2.08 [1.28, 3.40]) or a child (2.17 [1.75, 2.69]) but not after loss of other family members. Losing a child was associated with the outcome when the loss happened 2 years (1.48 [1.13, 1.93]), 5 years (1.52 [1.01, 2.30]), and 6 or more years prior to conception (1.54 [1.24, 1.91]).

3.7. Associations with type-specific mental disorders

Associations between family loss and specific mental disorders, namely depression, anxiety, psychotic and stress-related disorders are presented in Figure 3. After correction for multiple testing, we noted significant associations between exposure to any loss and all disorders, except for psychotic disorders. The strongest association was noted in case of losing a child and stress-related disorders (HR [95% CI]: 35.80 [34,50, 37.15]). Loss during the perinatal period was, however, also associated with psychotic disorders. For all types of mental disorders, we found a strong association after loss of a child and of a partner. Multiple losses were also more strongly associated with all types of mental disorder, except for psychotic disorders. A strong association was found for loss due to unnatural death, particularly in case of psychotic disorders.

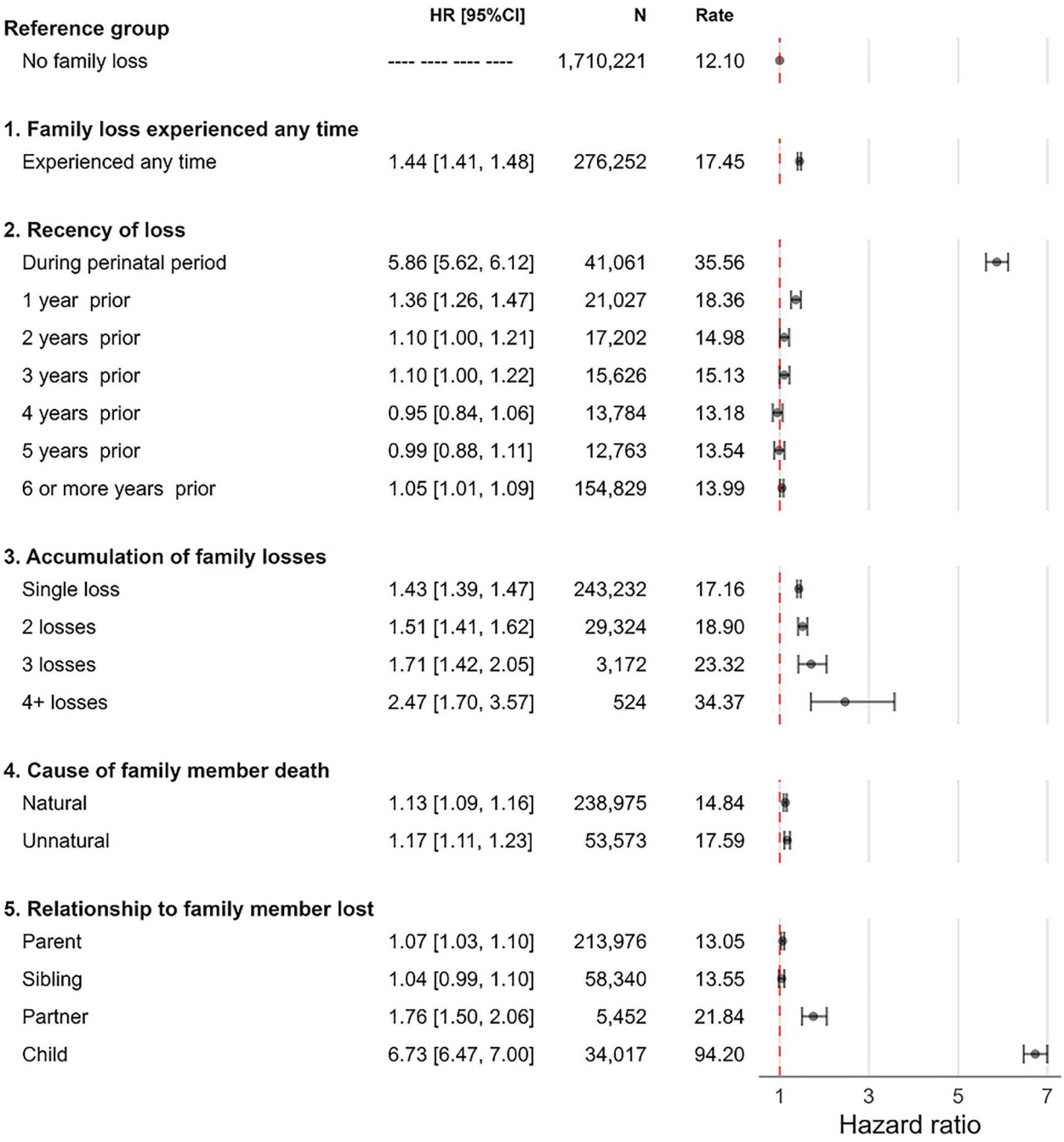

Figure 1. Associations between type of loss and perinatal mental disorders. All estimates were adjusted for age, country of birth, geographic area of residence, education, income, calendar year of pregnancy, number of family members during pregnancy, and family history of mental disorders. In model 2, recency of loss refers to before conception. Models 4 and 5 refer to most recent loss. The reference group for each estimate was never experienced family loss before or during the perinatal period. Error bars correspond to 95% confidence intervals.

4. Discussion

In this nationwide population-based cohort study, we found that death of a family member was associated with an increased risk of maternal mental disorders during the perinatal period, particularly if the loss occurred during the perinatal period. The risk of perinatal mental disorders was increased following any loss occurring up to one year before pregnancy and even earlier before in the case of loss of partner or child. The most pronounced association was observed for stress-related disorders. The associations with all mental disorders were particularly strong after loss of a child or partner, and, with the exception of psychosis, when several losses accumulated.

The current study is the first to report an association between bereavement before or during the perinatal period and a broad spectrum of perinatal mental disorders. Previously known major risk factors for first-onset mental disorders during the perinatal period consisted largely of pregnancy complications such as pre-eclampsia, emergency cesarean section and infant death (Blom et al., 2010). The present

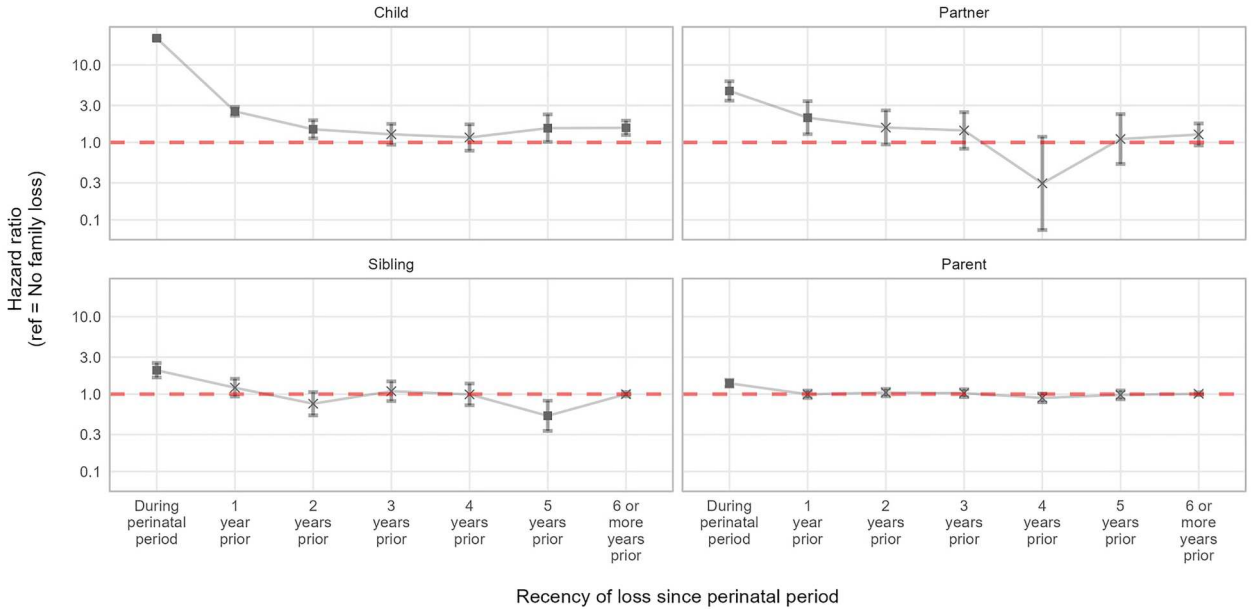

Figure 2. Time since loss prior to conception and its association with perinatal mental disorder of any type, stratified by the relationship to the deceased family member. Estimates obtained by creating dummy categories for each of the family member and time since loss. All estimates adjusted for age, country of birth, geographic area of residence, education, income, calendar year, number of family members during pregnancy and family history of mental disorders. The reference group for each estimate was never experienced family loss before or during the perinatal period.

results support findings from earlier studies that stressful life events, such as losing a partner or an older child, especially recently during the perinatal period compared to earlier in life, are associated with increased risks of all the type-specific perinatal mental disorders (Stroebe et al., 2007; Valsamakis et al., 2019). Moreover, a previous nationwide Danish study did not find an association between losing a parent in childhood and the risk of postpartum psychiatric disorders of any type (Meltzer-Brody et al., 2018). This, together with our findings that the association was strongest in case the loss occurred in the perinatal period, suggests that the recency of loss is an important factor for interpreting the overall associations presented here.

Our findings are also in line with the literature concerning the link between perinatal loss and the risk of all categories of perinatal mental disorders. Part of these strong associations could be due to stillbirth typically occurring in a hospital setting. While an earlier study suggested a 7–9-fold increase in depressive, anxiety and PTSD disorders after stillbirth or infant death, we found a 26 and 15-fold increased risk of all mental disorders following stillbirth and neonatal death respectively (Gold et al., 2016; Hogue et al., 2015). There are contrasting results on how subsequent pregnancies affect mothers' mental health. Some studies found that a longer time between stillbirth and the next conception may correspond to longer grief (Franche, 2001). However, it has further been reported that losing a child or stillbirth can increase anxiety and depressive symptoms in subsequent pregnancies, especially if the subsequent pregnancy begins in the year after the previous one (Blackmore et al., 2011; Keser & Kahya, 2024; Lamb, 2002). The current study quantifies the long-term consequences of stillbirth or losing a child, and suggest that the risks for perinatal mental disorders remain high for five years or longer after the initial loss. Moreover, the dose–response increase in risk according to the number of losses and after more recent losses is congruent with a tentatively causal interpretation of the estimates reported on.

In line with previous research, we found considerably higher risks for stress-related disorders compared to depressive disorders (Gold et al., 2016). Of note, a previous nationwide register-based study in Denmark and Sweden did not find an association between bereavement the year before or during pregnancy and the risk of postpartum psychosis (Warselius et al., 2019). In contrast, we observed that loss during the perinatal period was associated with an increased risk of psychotic disorders. It is unclear whether this discrepancy is due to the low incidence of postpartum psychosis or because perinatal psychosis is a distinct diagnostic entity from postpartum psychosis (Bergink et al., 2015). Conversely, a reverse causation may be possible, i.e. that the mother commits infanticide due to a psychotic episode, although such cases are exceedingly rare (Greenwood et al., 2023).

The current nationwide cohort study provides the most detailed investigation to date of how family death relates to perinatal mental health. Our results should nevertheless be interpreted in light of some

	Any psychiatric diagnosis (N=43,671)	Depressive disorders (N=16,016)	Anxiety disorders (N=15,739)	Stress-related disorders (N=11,921)	Psychotic disorders (N=854)
Reference group					
No family loss	---	---	---	---	---
1. Family loss experienced any time					
Experienced any time	1.44 [1.41, 1.48]***	1.15 [1.11, 1.20]***	1.08 [1.04, 1.12]***	2.31 [2.22, 2.39]***	1.16 [0.99, 1.36]
2. Recency of loss					
During perinatal period	5.86 [5.62, 6.12]***	1.91 [1.73, 2.10]***	1.59 [1.43, 1.77]***	16.90 [16.10, 17.75]***	2.16 [1.48, 3.16]***
1 year prior	1.36 [1.26, 1.47]***	1.34 [1.21, 1.49]***	1.17 [1.05, 1.31]**	1.93 [1.72, 2.16]***	1.08 [0.66, 1.78]
2 years prior	1.10 [1.00, 1.21]	1.01 [0.89, 1.15]	1.04 [0.91, 1.18]	1.16 [0.99, 1.36]	0.75 [0.39, 1.45]
3 years prior	1.10 [1.00, 1.22]	1.06 [0.93, 1.21]	1.05 [0.92, 1.20]	1.06 [0.89, 1.26]	1.48 [0.90, 2.43]
4 years prior	0.95 [0.84, 1.06]	0.97 [0.84, 1.13]	0.96 [0.83, 1.12]	1.16 [0.97, 1.39]	1.15 [0.64, 2.10]
5 years prior	0.99 [0.88, 1.11]	1.03 [0.89, 1.20]	1.08 [0.93, 1.25]	1.05 [0.86, 1.27]	1.03 [0.53, 1.99]
6 or more years prior	1.05 [1.01, 1.09]*	1.09 [1.04, 1.14]**	1.02 [0.97, 1.07]	1.17 [1.10, 1.24]***	1.06 [0.86, 1.30]
3. Accumulation of family losses					
Single loss	1.43 [1.39, 1.47]***	1.15 [1.11, 1.20]***	1.07 [1.03, 1.11]**	2.26 [2.17, 2.35]***	1.14 [0.96, 1.35]
2 losses	1.51 [1.41, 1.62]***	1.12 [1.01, 1.24]*	1.13 [1.02, 1.25]*	2.62 [2.40, 2.87]***	1.37 [0.93, 2.03]
3 losses	1.71 [1.42, 2.05]***	1.43 [1.12, 1.82]*	1.00 [0.74, 1.34]	3.14 [2.49, 3.95]***	0.40 [0.06, 2.87]
4+ losses	2.47 [1.70, 3.57]***	1.89 [1.14, 3.13]*	1.52 [0.86, 2.68]	4.40 [2.77, 7.00]***	2.00 [0.28, 14.27]
4. Cause of family member death					
Natural	1.13 [1.09, 1.16]***	1.14 [1.09, 1.19]***	1.10 [1.05, 1.14]***	1.68 [1.61, 1.75]***	1.02 [0.85, 1.24]
Unnatural	1.17 [1.11, 1.23]***	1.26 [1.18, 1.35]***	1.15 [1.07, 1.23]***	1.62 [1.50, 1.74]***	1.94 [1.51, 2.48]***
5. Relationship to family member lost					
Child	6.73 [6.47, 7.00]***	3.16 [2.94, 3.40]***	2.36 [2.18, 2.57]***	35.80 [34.50, 37.15]***	2.68 [1.98, 3.65]***
Parent	1.07 [1.03, 1.10]***	1.14 [1.10, 1.19]***	1.11 [1.06, 1.15]***	1.37 [1.30, 1.45]***	1.18 [0.98, 1.42]
Partner	1.76 [1.50, 2.06]***	1.74 [1.42, 2.13]***	1.59 [1.29, 1.97]***	4.79 [4.03, 5.68]***	2.67 [1.43, 4.99]**
Sibling	1.04 [0.99, 1.10]	1.08 [1.00, 1.16]	1.04 [0.97, 1.12]	1.48 [1.36, 1.62]***	1.05 [0.76, 1.47]

Figure 3. Associations between overall family loss and its subtypes with overall and specific perinatal mental diagnoses. All estimates were adjusted for age, country of birth, geographic area of residence, education, income, calendar year, number of family members during pregnancy and family history of mental disorders. The reference group for each estimate was never experienced family loss before or during the perinatal period. Asterisks represent *p*-values, * $p < .05$, ** $p < .01$, *** $p < .001$. False discovery rate adjustment was applied to all *p*-values on a per-row basis to correct for multiple testing across five outcomes.

limitations. First, the present study only included first-onset psychiatric disorders diagnosed in specialist care, while milder episodes of mental disorders could have been attended only by primary care or remained undiagnosed. As such, mental illness incidence rates during the perinatal period were considerably lower in the current sample. That said, it is plausible that due to the frequent contact with healthcare providers, women who experienced a loss during perinatal period were more likely to be detected for mental ill-health. However, the increased risk was also noted for loss happened 1–3 years before pregnancy, where such bias should be rather minimal. That said, it is plausible that due to the frequent contact with healthcare providers, women who experienced a loss during perinatal period were more likely to be detected for mental ill-health. However, the increased risk was also noted for loss happened 1–3 years before pregnancy, where such bias should be rather minimal. Second, despite specialist assigned diagnoses, misclassification of mental illness categories could resulted in complicated grief being categorized as depression, anxiety or a stress-related disorder. This limits the inference that can be drawn about associations with clinically distinct mental illness categories. We did, however, find an association with psychotic disorder beyond mood disorders, which suggests increased risk of psychiatric symptoms beyond those typically described by complicated grief. Third, it is further possible causes of death were misclassified as natural or unnatural, given that some causes were indeterminate based on the ICD-10 codes. Fourth, we cannot completely rule out residual confounding. Most categories of adulthood adversity are correlated with a dysfunctional childhood, which can substantially confound associations with health outcomes (Mann et al., 2021). Fifth, family members' deaths occurring outside of Sweden could not be captured. Such misclassification of exposure could further bias associations towards the null. Nevertheless, the nationwide coverage of all deaths allowed for precise estimation of family loss occurring in Sweden like timing and accumulation. Finally, the generalizability of the current findings outside the Scandinavian

populations and more broadly the Western European context is subject to further research.

In summary, our study suggests that loss of a family member is associated with an increased risk of first-onset mental disorders during the perinatal period. Although stillbirth and neonate death entailed some of the largest risk increments for perinatal mental disorders, losing a partner or a child due to death was also found to be a risk factor for stress-related disorders in particular, but also other mental disorders, including psychotic disorders. Finally, child loss, even as far as more than 5 years before pregnancy, is associated with an elevated risk of mental disorders. These findings highlight the importance of structured monitoring of women's mental health by integrating their social environment. Perinatal screener questions for mental health have already been established as acceptable and easy to complete without feelings of discomfort as perceived by mothers. The addition of family loss questions in risk assessments could therefore aid prevention and early detection of maternal mental disorders during perinatal period.

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Data availability statement

The raw datasets are not available for sharing due to privacy policies and regulations in Sweden.

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