

Gender differences in the risk of depressive disorders following the loss of a young child: a nationwide population-based longitudinal study

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Abstract

Background

Bereavement caused by the death of a child to the parents is one of the most traumatic life events. The aim of the current study is to investigate parental risk of seeking treatment for major depression disorders (MDD) in the year after a child's death and explores whether such bereavement effects may manifest differentially by parents' prior medical condition.

Methods

We studied a retrospective cohort of 7,245 parents (2,987 mothers and 4,258 fathers) identified in the National Health Insurance Research Database of Taiwan (NHIRD) who had lost a child with age between 1 and 12 years. For comparison, the parents of 1:4 birth year- and gender-matched non-deceased children were retrieved (16,512 mothers and 17,753 fathers). Gender-specific Cox regression analyses were performed to estimate risk.

Results

Nearly 3.5% and 1.6% of bereaved mothers and fathers sought treatment for major depressive disorders within the year of losing a child, significantly higher than 0.5% and 0.2% in the non-bereaved parents. With covariate adjustment, the hazard ratio (HR) for maternal and paternal bereavement effect was estimated 6.12 (95% confidence interval [CI]: 3.88–9.64) and 1.99 (95% CI: 1.09–3.63), respectively. The bereavement effects varied by prior disease history; specifically, the increased risk of major depression was especially prominent for those without chronic physical condition (CPC)(e.g., mothers with CPC: aHR = 3.60, 95% CI: 2.04–6.35 vs. no CPC: aHR = 10.58, 95% CI: 5.88–19.07).

Conclusions

Losing a young child can be a devastating life event. The observed negative effects are especially prominent for the women and those without prior medical history. Effective strategies addressing bereavement may require family-based, integrated physical and mental healthcare and even extended counseling service.

Background

Major depressive disorder (MDD), a leading cause of economic burden in many parts of the world, accounted for 8.2% of global years lived with disability in 2010 [1]. A recent review indicated that approximately 4.7% of global population currently have MDD, and the prevalence varied widely across

Loading [MathJax]/jax/output/CommonHTML/jax.js an, the incidence of treated MDD was on the notable rise over

the past decades. Among the individuals aged 45 to 54 years— the age group suffering from MDD most, the incidence for men and women was 2.15 and 4.51 per person-year, respectively [3]. Cumulative evidence has documented individual-level health and social characteristics associated with increased risk of onset and recurrence of MDD, including chronic diseases, disadvantaged socioeconomic status, low social integration, and stressful life events [4–7].

Experiencing the death of a loved family member often causes extremely complicated persistent grief despite coping mechanisms [8]. An increased risk of adverse health outcomes has been reported among the bereaved spouses, parents, and children [9–11], with the severity of bereavement often depending on the closeness and bonding between the living and the dead. The parent-child relationship has unquestionably been considered as the closest, and the grief after losing a child is often more intense and chronic. Studies have consistently demonstrated that the bereaved parents may experience greater physiological and psychological distress, including cancer, diabetes, depression, anxiety, suicide, and even death [12–15]. Such distress not only fluctuates over time but also varies by children's characteristics (e.g., age and unexpectedness of death)[7, 16]. For suicide, the risk was reported to emerge abruptly in the first months of child loss and appeared more salient if the child died in early childhood [17, 18].

Several parent-level characteristics have been documented to explain different risks of psychological distress after losing a child [5, 16, 19]. Gender is one attribute of great relevance in identifying possible etiological processes underlying bereavement effects [13, 18, 20, 21]. Mothers, by and large, grieve more than fathers. Specifically, women are more frequently to have both suicidal ideation and attempts, and even lower quality of life [16, 18]. Other than biological vulnerability, such gender differences in bereavement response may partly be the results of social role expectation and coping styles [22, 23]. Mothers were often the ones taking care of the demand posed by homemaking and childcare, and children take on great symbolic importance on married women's identity, especially in Asian societies. Some evidence indicated that in response to life events or stressors women appeared to use emotional coping styles more often, having their emotions expressive or confrontive. Men, on the other hand, were more likely to use detachment coping styles and have more emotional inhibition [24].

Losing a child may exert detrimental effects on parents differentially in terms of observational interval and outcome indicators [12, 19, 25]. Evidence from qualitative interviews and quantitative analyses consistently showed that the bereaved parents mostly took 3–4 years or even longer to put the child's death into perspective [19, 25]. A recent study analyzing 902 bereaved parents identified from the registry datasets in Finland found that the bereavement effects, as manifested in the use of psychotropic medications, reached the highest prevalence within the first year and fell sharply thereafter in the following three years. For children who died from diseases (not from external causes), the use of psychotropic medication was gradually elevated in the three years preceding the death of a child [19]. Meanwhile, a number of studies have noted that adverse health outcomes subsequent to a child loss may depend on subgroups defined by household characteristics, such as income status, household size,

and social network [5, 26]. For the bereaved mothers, poverty has been indicated as a strong predictor for psychological distress [5].

Although previous studies have highlighted some factors relevant to psychological distress of losing a child, the evidence was mostly collected in Western societies. In traditional Chinese culture, son is more important and preferred for not only economic reasons but his ability to continue the family lineage [27]. Also, these studies often built upon a relatively small sample size and cannot systematically characterize subgroup variation in parental bereavement. To fill the abovementioned research gap, we turned to the National Health Insurance data in Taiwan to identify a retrospective cohort of parents who lost their young children, following up throughout three years. Here, we used medical service of MDD in one year after the loss of a child as a proxy to reflect psychological distress. The present study aimed to (i) evaluate father- and mother-specific bereavement after losing a young child, and (ii) to investigate whether such bereavement effects may be manifested differentially by parents' prior health condition.

Methods

Data sources

Data for the present study came from the 1998-2013 National Health Institute Research Data (NHIRD), derived from the National Health Insurance Plan (NHIP) in Taiwan. The NHIP is a mandatory, single-payer health insurance for all citizens and legal residents, providing healthcare in outpatient, ambulatory, and inpatient service systems. Implemented since 1995, the estimated coverage rate reached 99.5% of the population by the end of 2005. In the NHIP, patients with "catastrophic illness", defined as severe illness requiring prolonged hospitalization or treatment, will receive the certificates to exempt them from copayments.

Study design

The present study used a retrospective matched cohort study. Given that the exposure event is the loss of a young child, we first obtained a subgroup of young individuals who died no older than 12 during the year from 2002 to 2010 (see Supplementary Figure 1)($n=10,926$). The records concerning death were ascertained and validated through three sources: insurance status (i.e., withdrawal due to death), treatment records for disease listed as among the 10 leading causes of death for children, and no healthcare records after insurance withdrawal. For comparative purpose, we obtained the children age under 12 who were alive as of the end of 2010 ($n=5,809,757$). The linkage rate between the index child with at least one parent was 91% for the deceased group, and such rate in the comparison group was 96%. Since for reimbursement purposes, medical treatments for severe or congenital diseases were often recorded in the mother's healthcare insurance account before the infants had their own individual identification numbers, the present study therefore decided to focus on children who died after reaching their first birthday ($n=5,881$); and their age- and gender-matched living peers were further randomly selected in a ratio of 1:4 ($n=23,524$). For the deceased children, the linkage rate with fathers and mothers

was accordingly 72.3% and 50.7%, respectively, slightly lower than the corresponding estimate for the living children (i.e., 75.5% and 70.2%, respectively).

Measures

Outcome variable. Medical service for MDD (including major depression and any depressive disorder) was defined by the International Classification of Disease, Ninth Revision, Clinical Modification [ICD-9-CM] (296.2X, 296.3X, 300.4X, and 311), given by a board certificated psychiatrist during at least two outpatient services or one inpatient service [28, 29]. The time to the MDD treatment was obtained from the first visit within one and three years of the index children's death date.

Other variables. Children's characteristics included gender, age, and duration of the catastrophic illness (i.e., non, less than one year, and one year or longer). Family characteristics included economic status (i.e., income) and residential urbanicity (i.e., urban vs. rural region); linkage with the other parent other than the present insurance payer was obtained to reflect household variation in employment history since the birth of the index child – a proxy measure for parents' market participation [30]. Mother/father characteristics included age at the death of the index child and premium payer (a proxy for labor market participation). History of chronic physical condition (CPC) (i.e., malignant neoplasms [ICD 9-CM: 140-208], chronic liver disease and cirrhosis [ICD 9-CM: 571], heart disease [ICD 9-CM: 390-392, 393-398, 410-414, 420-429], cerebrovascular disease [ICD 9-CM: 430-438], diabetes [ICD 9-CM: 250], hypertensive disease [ICD 9-CM: 401-405], bronchitis [ICD 9-CM: 490-491], emphysema [ICD 9-CM: 492], asthma [ICD 9-CM: 493], and atherosclerosis [ICD 9-CM: 440]), along with depressive disorders, were also retrieved in the three years before the death of the index child.

Statistical analyses

Cross-tabulation was first conducted to summarize selected parents' and children's characteristics with stratification by exposure (i.e., losing a young child), with differences being evaluated by Chi-square test. Next, the hazard of doctor visit for MDD by losing a child was estimated and the smoothed hazard function was depicted in the Figure 1. The time to event was initially calculated as months after the index child's death till the occurrence of receiving the first diagnosis of depression, death (i.e., parent's insurance withdrawal due to death), 36 months, or the end of observation (December 31, 2013), depending on which came first. The plot inspection indicated that the hazard overlapped or even cross-over after the first year (i.e., violation of the proportional hazard assumption), therefore we decided that the Cox proportional hazard regressions were used to estimate the risk of having received treatment for MDD over the first year only (but the results were compatible with three-year ones).

With stratification by parental gender, we first obtained crude hazard ratio of losing a child with MDD treatment, followed by simultaneous adjustment for child, family, and parental characteristics (Models I and II). The risk was presented in crude and adjusted hazard ratios (HR), with 95% confidence intervals (CI) as an aid for interpretation. Finally, potential heterogeneity in bereavement effects was also probed health condition (i.e., CPC and MDD). A p-value less than

0.05 was considered statistically significant. All analyses were performed using SAS version 9.4 (SAS institute, Cary, NC, USA).

Results

Among those deceased children, nearly one third ($n=1,861$) (31.6%) had a catastrophic illness for more than 1 year compared to 1.4% ($n=320$) in their birth-year- and gender-matched peers (see Table 1). Approximately 34% of deceased children's health insurance was covered by their mothers (i.e., the mother had a job), significantly lower than the 44% in their counterparts. In general, the parents of deceased children were more likely to be older (e.g. mothers: 35 years old or older: 44% vs. 41%), to have prior history of MDD (e.g., fathers: 1.83% vs. 0.28%), and to have CPC (e.g., fathers: 39% vs. 12%). Three-point-five percent of bereaved mothers and one-point-six percent of bereaved fathers have sought treatment for MDD within the year of child loss.

With stratification by gender, the estimated hazard of seeking MDD treatment within the three-year of a young child loss was depicted in Fig. 1. For both fathers and mothers, the hazards in the bereaved parents unanimously fell within the first year (see the solid lines) and reached the platform near the 9th month; nevertheless, the cross-over in the hazard was noticed thereafter in those with prior MDD or CPC. Regardless of parents' gender, the higher hazard of MDD treatment was observed among those who had prior history of health condition.

For the middle-aged mothers, univariate Cox regression analyses indicated that having lost a child ($HR=7.61$), having the prior history of MDD ($HR=97.68$), and having a CPC ($HR=9.69$) were the three strongest predictors for increased hazard of visiting a doctor for MDD (see Table 2). In addition, having a child receive a diagnosis of a catastrophic disease (e.g., cancer) may increase maternal hazard of receiving the treatment for MDD by 164% (less than one year) and 422% (one year or more), and disadvantaged income may also slightly increase such risk (poverty: $HR=2.57$). With statistical adjustment for child's health and family characteristics, losing a child was found to increase the hazard of receiving the treatment of MDD by 586% (Model I: 95% CI = 4.72-9.97), and such risk was slightly attenuated while maternal sociodemographic and health characteristics were taken into account simultaneously (Model II: $aHR=6.12$; 95% CI = 3.88-9.64).

The profile of significant predictors for receiving the treatment of MDD in fathers was similar with those in mothers, although variation exists in the magnitude (Table 3). The crude hazard ratio of MDD associated with losing a child was 4.71 in fathers, and the hazard ratio linked with prior history of depression was as high as 159.59. For the middle-aged men, having a child with a catastrophic illness for one year or more and disadvantaged incomes may accordingly increase the hazard of MDD treatment seeking by 224% and 105% ($p<0.01$). With all listed variables adjusted simultaneously, losing a young child was found to increase fathers' risk of depression by 99% (Model II: 95% CI = 1.09-3.63).

With a focus on risk variation in the subgroup defined by prior health condition, we found that the Loading [MathJax]/jax/output/CommonHTML/jax.js y prominent for those parents who received no medical

treatment for chronic condition (or were relatively “healthy”) in the three years prior to the death of the index child (Figure 2). For example, losing a child was associated with adjusted HR of 10.58 among those non-CPC affected mothers, whereas the estimate was only 3.60 for those who had at least one CPC. For fathers, such increased hazard of bereavement was indeed only significant for those who previously had no CPC (aHR=6.06; 95% CI = 2.64-13.89) and had no MDD (aHR=2.82; 95% CI = 1.46-5.43).

Discussion

We utilized population-based data to ascertain young children and their parents to investigate the extent to which losing a young child may affect subsequent development of bereavement, as indexed by the utilization of MDD treatment, in the middle-aged parents and explore potential parents-level heterogeneity in “bereavement effect”. Our analyses showed that the risk of treatment seeking for MDD was especially prominent in the first three quarters after losing a child. The occurrence of MDD treatment was elevated by 6.12-fold in the bereaved mothers, nearly three times higher than 1.99-fold in fathers. Notably, the so-called “bereavement effects” manifested differentially across individuals sub-grouped by prior health condition. Specifically, the significant increased risk of seeking MDD treatment was more salient in those who had no prior MDD or those who had no CPC (e.g., diabetes and hypertensive disease), especially in fathers.

Disturbed/complicated grief is distinct from depression and post-traumatic stress disorder, although the rates of comorbidity between these conditions are high and the duration can be longer than 6 to 12 months after the episode of loss [31–34]. To certain extent, our data may partly correlate with the new diagnostic condition of DSM-V and ICD-11 for bereavement (persistent complex bereavement disorder and prolonged grief disorder, respectively) [35, 36] and demonstrated that parental bereavement could last for at least one year (Fig. 1). Slight child loss-related excess in the hazard of MDD treatment remained for three years in our study (especially those who had prior medical conditions); nevertheless, different from previous studies [19, 37, 38], such increased risk was less prominent after the first 12 months. This discrepancy may be partly due to the variation in (i) cultural or societal differences in clinical manifestation of MDD and perceived need in treatments seeking and (ii) the nature of outcome indicators (e.g., MDD vs. antidepressant; incident vs. prevalent cases)[39–41].

Children’s health condition has long been recognized as a source of major life events substantially shaping child-rearing adults’ mental health, which is particularly true when children were affected by chronic or catastrophic illness, such as cancer [42–44]. Our analyses showed that caring for a child with at least one catastrophic illness might moderately elevate subsequent risk of MDD treatment, and the increased risk of MDD treatment was also elevated by the chronicity of illness. Nevertheless, such risk was no longer significant as we took bereavement and disadvantaged economic status into account, highlighting the salient independent effects of losing a child. Importantly, the negative emotional effects associated with bereavement may manifest far beyond six months [7, 37, 45–47]. The observed “bereavement effects” in this study population were slightly greater than those reported previously in

other Western societies (e.g., Canada), which may be explained by children's cause of death, parent-child bonds, family structure or size, follow-up period, and fertility rate [16, 27, 38, 48].

Our results corroborate previous findings that mothers may suffer more from bereavement than fathers while facing the loss of a child [13, 17, 19, 49]. The mechanisms underlying the observed gender differences in seeking treatment for MDD may be attributed to a mixed result of vulnerability, stress coping, help seeking, and role expectation in childcare [19, 50]. For example, the loss of a child may pose a threat to the identity of bereaved parents. Since the majority of primary caregivers for children are women in this study context, this adjustment process can be challenging for mothers and even more difficult for those unemployed ones with limited social support or a poor social network [51–53]. On the other hand, fathers often adopt emotional inhibition, detachment, or denial (i.e., ignoring their grief) as coping strategies, leading to unawareness of or even unresponsiveness to psychological distress. What makes the grief process complicated in the study context is that men may encounter more culture or societal barrier in seeking medical help for mental health problems [39, 41]. In addition, given that the fathers may be the only breadwinner in the families of deceased children (see Table 1 for the relatively lower employment rate for mothers), the bereaved fathers likely accommodate the child loss with more work (or income) in order to regain the order of life, leaving no time for grief or selfcare. Indeed, we noticed that the fathers who sought treatment for MDD in the year after losing a child was even lower than those with a previous history of MDD (66 vs. 78 in Table 1), indicating potential gap in mental health services for this high-risk group and highlighting the need to implement targeted or tailored intervention [54–56].

Although the relationship between child loss and parental adverse health condition is fairly well established, the magnitude of bereavement effects is potentially complex because of parents' attributes [15, 19, 55]. Our study illuminates that the parental bereavement effect may vary by prior health condition; specifically, the increased risk of treatment seeking for MDD was notably pronounced in those without prior history of MDD or CPC. Three probable explanations may account for this phenomenon. First, although child loss is a traumatic event, child-rearing, especially for the kids with catastrophic illness, is often a long and even financially and emotionally demanding process [43, 44]. Some parents may be aware of psychological distress and seek treatment long before the child's death, as indicated by the work reporting that parental utilization of antidepressants or anxiolytics was gradually elevated in the three years before they lost a child to diseases [19]. This possibility is further reinforced by our analyses showing that prior prevalence of MDD treatment among bereaved parents was 4-6-times higher than their comparison peers. Second, for parents with physical or mental health problems, a visit to a doctor can offer a great opportunity to call for medical attention to somatic problems or stress-related symptoms (e.g., adjusting medication or therapy); thus, subsequent risk of MDD treatment associated with child loss may be alleviated. This also implicated the efficacy of timely medical intervention for parental bereavement before a child's death. Third, the observation may reflect the delay in treatment seeking and the rebound after loss of their child. Preoccupation with care work (especially for the severely ill children) may face time or financial constraints, increasing the barriers to accessing appropriate healthcare [54].

Some potential limitations of the present study should be acknowledged before further interpretation. First, the definition of exposure (i.e., child's death) was primarily ascertained from health insurance records (e.g., insurance withdrawal), therefore restraining our ability to further characterize the heterogeneity of child's death (e.g., cause of death) [19, 57]. Nevertheless, we carried out a series of post-hoc analyses to explore whether the connection between losing a child and MDD treatment by expectedness of child death. The interaction terms with the duration of catastrophic illness appeared to be nonsignificant in both father and mothers ($p > 0.05$), indicating that potential bereavement effects were rather consistent. Another issue involves specification of parent-child pairs in relation to health insurance status. The insurance premium payer is usually determined by several factors (e.g., labor force participation and salary), some of which also have been found as correlates for bereavement [5]. The differential linkage rate in mother-child pairs (i.e., 50% in the deceased vs. 70% in the living, see Supplementary) may possibly result in the underestimated risk of depression for the bereaved parents. Finally, the sole reliance on health insurance data can be problematic when only variables relevant to reimbursement can be gathered. Further exploration of variables at the child-, parents-, and household-levels was not feasible in this study; they should be evaluated in future research to better understand possible mechanisms.

Notwithstanding the limits just described, the present study has several strengths. To date, our study represents one of just a few population-based studies conducted in non-Western societies to investigate so-called parental bereavement effects. The large sample size and three-year follow-up period granted us the opportunity to delineate the effects of losing a child on father and mothers with a rather thorough perspective. Societies or cultures with similar parent-child bonding may benefit from this study in framing the concept of parental bereavement, which is particularly urgent in the context wherein mental health awareness is relatively limited and the need in mental healthcare is often overlooked.

Conclusions

Our findings provide compelling evidence for an association between losing a young child and increased treatment seeking for major depressive disorders in the subsequent one year. Timely intervention to reduce psychological distress in parents who have a child died depends on recognition of reaction and adaptation (e.g., withdrawal from social interaction) by pediatric services providers in inpatient and emergency department or home visits [5, 44, 47, 58]. For many parents, particularly those in disadvantaged economic or social network groups, the intervention may also involve financial aid and social support (e.g., patient groups). Effective strategies addressing enduring bereavement may require family-based, integrated physical and mental healthcare, and even extended counseling service long before the death of a child (e.g., pediatric hospice or intensive care unit). Additional studies of follow-up service delivery of intervention for those bereaved parents or caregivers are warranted, especially those who have received little medical attention in the process of caring for a seriously ill child or limited mental health literacy.

Abbreviations

aHR: adjusted hazard ratio

CPC: chronic physical condition

HR: hazard ratio

ICD-9-CM: International Classification of Diseases, Ninth Revision, Clinical Modification

MDD: major depressive disorders

NHIP: National Health Insurance Plan

NHIRD: National Health Insurance Research Database

Declarations

Ethics approval and consent to participate

The Institutional Review Board of the National Yang-Ming University approved this study and waived the need for individual consents since all the identification data were encrypted in the NHIRD (IRB No. YM104106E)

Consent for publication

Not applicable

Availability of data and materials

Data are available from the National Health Insurance Research Database (NHIRD) published by the Taiwan National Health Insurance (NHI) Administration. Due to legal restrictions imposed by the government of Taiwan concerning the “Personal Information Protection Act”, data cannot be made publicly available. Requests for data can be sent as a formal proposal to the NHIRD.

Competing interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Authors' contributions

Dr. Hsin-Hung Chen the initial manuscript. Dr. Shao-You Fang and Ms. I-An Wang carried out the data preparation and analysis. Dr. Chuan-Yu Chen conceptualized and designed the study, coordinated, and supervised data analysis. Dr. Yiing-Jenq Chou critically reviewed the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Tables

Table 1 Characteristics of children who died and paired cohort with their parents.

Characteristics	Deceased children		Non-deceased children		P-value
	n	%	n	%	
Total	5,881	100.00	23,524	100.00	
<u>Child's and family characteristics</u>					
Gender					1.0000
Male	3,262	55.47	13,048	55.47	
Female	2,619	44.53	10,476	44.53	
Age at death					1.0000
1-2 years	1,792	30.47	7,168	30.47	
3-6 years	2,250	38.26	9,000	38.26	
7-12 years	1,839	31.27	7,356	31.27	
Diagnosis of catastrophic illness before death					<0.001
Less than one year	856	14.56	162	0.69	
One or more years	1,861	31.64	320	1.36	
No	3,164	53.80	23,042	97.95	
Income level ^b					<0.001
Poverty	1,951	33.17	3,898	16.57	
Medium	2,448	41.63	11,909	50.32	
High	1,257	21.37	7,087	30.13	
Missing	225	3.83	630	2.68	
Urbanization ^b					<0.001
Urban	1,515	25.76	6,448	27.41	
Suburban	3,614	61.45	14,561	61.90	
Rural	650	11.05	2,054	8.73	
Missing	102	1.73	461	1.96	
Premium payer ^b					<0.001
Father	3,247	55.21	12,268	52.15	
Mother	2,032	34.55	10,354	44.01	
Other ^a	488	8.30	378	1.61	
Missing	114	1.94	524	2.23	
<u>Maternal characteristics (N=19,499)</u>					
Maternal age at child's death					0.0099
< 35 years	1,667	55.81	9,633	58.34	
≥35 years	1,320	44.19	6,879	41.66	
Maternal depressive disorders before child's death ^c					<0.001
Yes	71	2.38	94	0.57	
No	2,916	97.62	16,418	99.43	
Maternal chronic physical condition ^d					<0.001
Yes	1,060	35.49	1,875	11.36	
No	1,927	64.51	14,637	88.64	
Treatment seeking for depressive disorders after child's death ^e					<0.001
Yes	103	3.45	76	0.46	
No	2,884	96.55	16,436	99.54	
Treatment seeking for depressive disorders after child's death ^f					<0.001
Yes	123	4.12	108	0.65	
No	2,864	95.88	16,404	99.35	
<u>Paternal characteristics (N=22,011)</u>					
Paternal age at child's death					<0.001
< 35 years	1,338	31.42	6,534	36.81	
≥35 years	2,920	68.58	11,219	63.19	
Paternal depressive disorders before child's death ^c					<0.001
Yes	78	1.83	49	0.28	
No					

No	4,180	98.17	17,704	99.72	
Paternal chronic physical condition ^d					<0.001
Yes	1,650	38.75	2,214	12.47	
No	2,608	61.25	15,539	87.53	
Treatment seeking for depressive disorders after child's death ^e					<0.001
Yes	66	1.55	43	0.24	
No	4,192	98.45	17,710	99.76	
Treatment seeking for depressive disorders after child's death ^f					<0.001
Yes	84	1.97	75	0.42	
No	4,174	98.03	17,678	99.58	

Refers to insurance covered under the name of the child himself or herself or the name of a grandparent.

n the year before the index child's death.

Depressive disorder (ICD-9-CM codes: 296.2X, 296.3X, 300.4X, and 311) is confirmed by receiving a diagnosis by a psychiatrist in (i) two or more outpatient services or (ii) one inpatient service within three years before the index child's death.

Chronic physical condition — including malignant [neoplasms](#), chronic liver disease and cirrhosis, heart disease, cerebrovascular disease, diabetes, hypertensive disease, bronchitis, emphysema, asthma, and atherosclerosis — were obtained from the three-year reimbursement records prior to the index child's death.

Depressive disorder (ICD-9-CM codes: 296.2X, 296.3X, 300.4X, and 311) is confirmed by receiving a diagnosis by a psychiatrist in (i) two or more outpatient services or (ii) one inpatient service in one year after the index child's death.

Depressive disorder (ICD-9-CM codes: 296.2X, 296.3X, 300.4X, and 311) is confirmed by receiving a diagnosis by a psychiatrist in (i) two or more outpatient services or (ii) one inpatient service in the three years after the index child's death.

Table 2 Child loss in relation to subsequent treatment of major depressive disorders in mothers (N=19,499)

Variables	n	%	Crude HR	P-value	Model I ^a		Model II ^a	
					aHR	95% CI	aHR	95% CI
<u>Children's characteristics</u>								
Death								
≥ 1 year	2,987	15.32	7.61	<0.001	6.86***	4.72-9.97	6.12***	3.88-9.64
< 1 year	16,512	84.68	1.00		1.00		1.00	
Diagnosis of catastrophic illness								
≥ 1 year or more	1,198	6.14	5.22	<0.001	1.28	0.84-1.97	1.05	0.63-1.74
< 1 year	576	2.95	2.64	0.004	0.70	0.34-1.42	0.61	0.27-1.42
	17,725	90.90	1.00		1.00		1.00	
<u>Family characteristics</u>								
Home level^b								
High	5,708	29.27	1.00		1.00		1.00	
Medium	9,605	49.26	1.57	0.026	1.24	0.82-1.86	1.16	0.72-1.87
Low	3,686	18.90	2.57	<0.001	1.39	0.87-2.20	1.00	0.58-1.73
Organization^b								
Non-urban	5,655	29.00	1.00		1.00		1.00	
Urban	12,124	62.18	1.32	0.127	1.37	0.95-1.98	1.42	0.93-2.18
Other	1,444	7.41	1.34	0.351	1.23	0.66-2.30	1.37	0.64-2.92
Age with father in health insurance								
≥ 1 year	12,105	62.08	1.00		1.00		1.00	
< 1 year	7,394	37.92	1.57	0.003	1.19	0.87-1.63	0.99	0.64-1.52
<u>Maternal characteristics</u>								
Age at child's death								
≥ 5 years	11,300	57.95	1.00				1.00	
< 5 years	8,199	42.05	1.45	0.020			1.25	0.84-1.85
Insurance payer (mother)^c								
≥ 1 year	12,386	63.52	1.00				1.00	
< 1 year	6,753	34.63	1.02	0.926			1.08	0.69-1.69
Depression disorders^d								
≥ 1 year	165	0.85	97.68	<0.001			66.42***	40.48-108.99
< 1 year	19,334	99.15	1.00				1.00	
Chronic physical condition^e								
≥ 1 year	2,935	15.05	9.69	<0.001			3.71***	2.55-5.40
< 1 year	16,564	84.95	1.00				1.00	

Model I adjusted for children's listed characteristics, gender, and age; Model II adjusted for children's and maternal characteristics; *** $P<0.001$; ** $P<0.01$; * $P<0.05$

In the year before the index child's death.

"No" refers to health insurance covered by the father, the children themselves, and grandparents.

Depressive disorder (ICD-9-CM codes: 296.2X, 296.3X, 300.4X, and 311) is confirmed by receiving a diagnosis by a psychiatrist in (i) two or more outpatient services or (ii) one inpatient service within three years before the index child's death.

Chronic physical condition — including malignant [neoplasms](#), chronic liver disease and cirrhosis, heart disease, cerebrovascular disease, diabetes, hypertensive disease, bronchitis, emphysema, asthma, and atherosclerosis — were obtained from the three-year reimbursement records prior to the index child's death.

Table 3 Child loss in relation to subsequent treatment of major depressive disorders in fathers (N=22,011)

Variables	N	%	Crude HR	P-value	Model I ^a		Model II ^a	
					aHR	95% CI	aHR	95% CI
<u>Children's characteristics</u>								
Death								
Yes	4,258	19.34	4.71	<0.001	5.83***	3.68-9.25	1.99*	1.09-3.63
No	17,753	80.66	1.00		1.00		1.00	
<u>Diagnosis of catastrophic illness</u>								
One year or more	731	3.32	3.24	<0.001	0.98	0.57-1.70	1.20	0.60-2.42
Less than one year	1,646	7.48	2.91		0.005	0.98	0.44-2.15	0.75
No	19,634	89.20	1.00		1.00		1.00	
<u>Family characteristics</u>								
Income level ^b								
High	6,265	28.46	1.00		1.00		1.00	
Medium	10,637	48.33	0.94	0.791	0.91	0.55-1.52	1.00	0.54-1.86
Low	4,597	20.89	2.05	0.006	1.46	0.85-2.48	1.75	0.90-3.40
Urbanization ^b								
Rural	5,786	26.29	1.00		1.00		1.00	
Semi-urban	13,743	62.44	1.39	0.180	1.33	0.82-2.17	1.52	0.83-2.77
Urban	2,112	9.60	1.14	0.737	1.12	0.51-2.45	1.23	0.50-3.03
<u>Insurance coverage with mother in health insurance</u>								
Yes	12,105	55.00	1.00		1.00		1.00	
No	9,906	45.00	1.69	0.008	1.08	0.71-1.63	1.06	0.59-1.90
<u>Paternal characteristics</u>								
Time at child's death								
Less than 5 years	7,872	35.76	1.00				1.00	
5 years or more	14,139	64.24	1.61	0.039			0.82	0.48-1.42
<u>Insurance payer (father)^c</u>								
Yes	15,515	70.49	1.00				1.00	
No	6,129	27.85	1.07	0.765			0.80	0.42-1.53
<u>Depressive disorders before child's death^d</u>								
Yes	127	0.58	159.59	<0.001			93.94***	45.89-176.89
No	21,884	99.42	1.00				1.00	
<u>Chronic physical condition^e</u>								
Yes	3,864	17.55	10.51	<0.001			5.00***	3.04-8.24
No	18,147	82.45	1.00				1.00	

Model I adjusted for children's listed characteristics, gender, and age; Model II adjusted for children's and paternal characteristics; *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$

in the year before the index child's death.

No" refers to health insurance covered by the mother, the children themselves, and grandparents.

Depressive disorder (ICD-9-CM codes: 296.2X, 296.3X, 300.4X, and 311) is confirmed by receiving a diagnosis by a psychiatrist in (i) two or more outpatient services or (ii) one inpatient service within three years before the index child's death.

Chronic physical condition — including malignant neoplasms, chronic liver disease and cirrhosis, heart disease, cerebrovascular disease, diabetes, hypertensive disease, bronchitis, emphysema, asthma, and atherosclerosis — were obtained from the three-year reimbursement records prior to the index child's death.

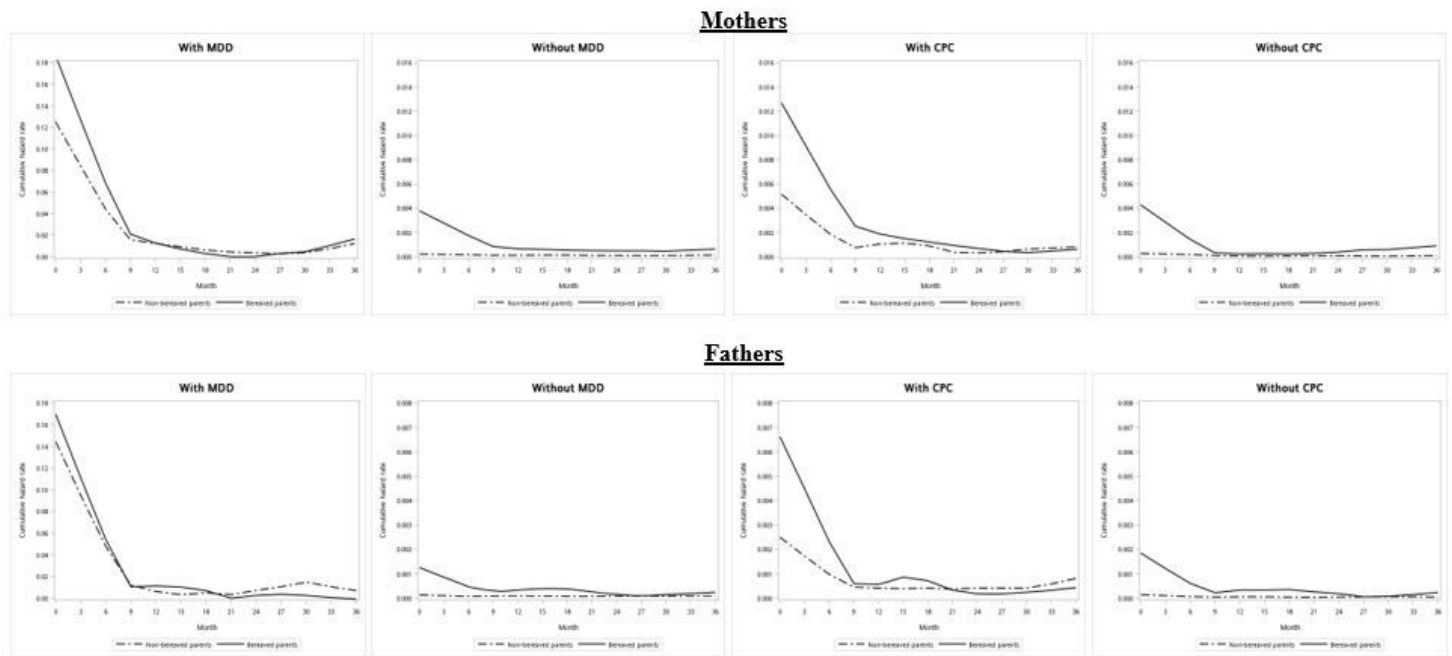
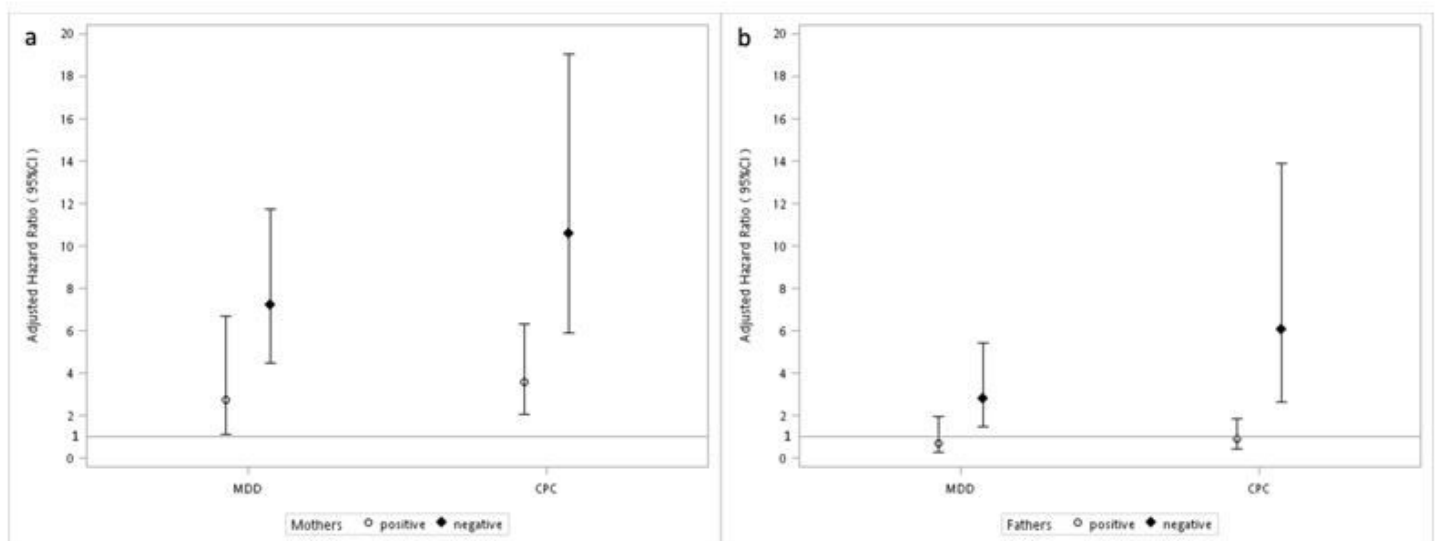


Figure 1

Smoothed hazard estimates in the mothers (upper panel) and fathers (lower panel) by losing a child, with stratification by prior history of major depressive disorder (MDD) and chronic physical condition (CPC)



The interaction terms between losing a child and prior health condition were all statistically significant ($p < 0.05$) in both mothers (a) and fathers (b).

Figure 2

Adjusted hazard ratios of seeking treatment for major depressive disorders for the bereaved mothers and fathers, by prior history of major depressive disorders (MDD) and chronic physical condition (CPC)

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