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DISCUSSION PAPER SERIES

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ABSTRACT

Dark Passage: Mental Health Consequences of Parental Death*

This paper studies the causal effect of parental death on children's mental health. Combining several nationwide register-based data for Finnish citizens born between 1971 and 1986, we use an event study methodology to analyze hospitalization for mental health-related reasons by the age of 30. We find that there is no clear evidence of increased hospitalization following the death of a parent of a different gender, but there are significant effects for boys losing their fathers and girls losing their mothers. Depression is the most common cause of hospitalization in the first three years following paternal death, whereas anxiety and, to a lesser extent, self-harm are the most common causes five to ten years after paternal death. We also provide descriptive evidence of an increase in the use of mental health-related medications and sickness absence, as well as substantial reductions in years of schooling, employment, and earnings in adulthood for the affected children.

JEL Classification: I10, I12, J12, J13

Keywords: parental death, mental health, hospitalization, depression, labor market

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Introduction

Children face many challenges on their path to adulthood. Probably the most difficult situation a child can face is the death of a parent. In these circumstances, children are forced to encounter and overcome a likely reduction in family income, a loss of parental guidance and social support, and many other shortfalls that other children do not have to face. Parental death has consequences on children across a host of outcomes such as future educational outcomes, labor-market outcomes, family formation, and health.

Mental health is an increasingly important determinant of overall health in developed countries (Layard, 2013), with depression being the largest contributor to the disease burden attributable to non-fatal health outcomes (Whiteford et al., 2013). Early mental health-related problems often accumulate into negative health and non-health consequences in adulthood. For example, mental health problems may lead to poor physical health (Sareen et al., 2006) as well as work-related losses, such as lower work performance and increased absenteeism (Bubonya, Cobb-Clark, and Wooden, 2017).

Despite the increasing importance of mental health, economic research has only rarely analyzed the effect of parental death on the child's mental health. In this paper, the preferred outcome is hospitalization for mental health-related reasons. We also examine other closely related outcomes such as the use of mental health-related medications and sickness absence. Our analysis is based on nationwide register-based data from Finland for individuals born between 1971 and 1986, in order to measure hospitalization through the age of 30.

Our preferred specification is an event study framework akin to the model used by Kleven, Landais, and Egholt Søgaard (2019) and Kristiansen (2021), in which we follow individuals before and after a parental death at ages 10–20. An extension to the event study model uses children who did not experience a parental death as a comparison group. Our supplementary analysis uses a cross-sectional model based on additional outcomes such as sickness absence, employment, and earnings in adulthood.

Strikingly, based on the event study models, we find that losing a parent of one's own gender has a much larger negative effect on mental health, than losing a parent of the opposite gender. For males, the loss of the father nearly doubles the pre-parental-death mean hospitalization rate. Although the effect diminishes in later years, it is still economically and statistically significant three years after the death. The overall effect of the mother's death on females fades noticeably faster. We find little if any evidence of adverse mental health outcomes associated with the mother's death for males or the father's death for females. This pattern of results is similar, whether or not we use children who did not experience a parental death as a control group. Looking at the cause of hospitalization, depression is the most pronounced cause in the short run, and anxiety in the long run among males, after a paternal death. Further, we document results using several additional outcomes. We find substantial increases in the use of mental health-related medications, sickness absence and employment/earnings losses for the affected children in adulthood.

Relationship to Previous Work

Originally, economists studied parental death because they considered it the most exogenous source of parental absence. In a meta-analysis, Amato (1993) conjectures that the negative effects of parental divorce and parental death on educational, labor-market, and social outcomes are equivalent. However, the results from a meta-analysis also suggest that parental divorce had larger negative consequences than parental death. Rather than studying the effect of parental death on economic outcomes, Corak (2001) uses children who experience a parental death as a comparison group for children whose parents divorce, finding few differences between these two groups in multiple labor-market outcomes.

Two early studies look simultaneously at the effects of parental death and parental divorce, using OLS models on rich, cross-sectional survey data. Lang and Zargosky (2001) argue that parental death is relatively exogenous, and include measures of parental death in their analysis of National Longitudinal Survey of Youth data. Rather than measure the effect of death itself, the authors create variables measuring the number of years of childhood with a deceased parent. In regressions that also include the number of years living with each parent, Lang and Zargosky (2001) find no discernable effect of parental death on numerous economic outcomes in adulthood.

Similarly, Fronstin, Greenberg, and Robins (2001) study both parental divorce and father's death (data on mother's death were not collected) on outcomes at age 33, using the British National Child Development Survey. Looking either at the effect of death overall or at the effect at different ages of the child, they find no systematic relationship between father's death or parental divorce on labor-market status or earnings by gender.

More recently, Steele, Sigle-Rushton, and Kravdal (2009) look at both marital dissolution (separation or divorce) and father's death using Norwegian administrative data. To account for potential selection into marital dissolution, they use a simultaneous equations model with separate models for marital dissolution and for children's education. In their preferred model accounting for selection, they find similar negative impacts for marital separation and father's death on the transition from lower to higher secondary education.

Chen, Chen, and Liu (2009) use detailed registry data from Taiwan to study the effect of accidental parental death on the likelihood of college enrollment at age 18. Their preferred model is a family fixed effect model that compares siblings who were 18 or more when the parent died, with younger siblings. They find that any maternal death is associated with a two-percentage-point reduction in college attendance, compared to a reduction of more than four percentage points for accidental maternal deaths. The impact of paternal death is small and insignificant. Because both siblings are probably near 18 in age, Adda, Björklund, and Holmlund (2011) note that results from this technique are unlikely to be capable of generalization to the entire population of parental deaths. Kailaheimo-Lönnqvist and Erola (2020) also utilize family fixed effect models and find negative impacts of early parental death on children's university education, in Finland.

Also using registry data, Adda, Björklund, and Holmlund (2011) study the relationship between parental death, education and earnings. They report negative effects of parental death, with more pronounced effects for mothers' death in OLS regressions, either for all deaths or as a subset of plausibly exogenous causes of death. When they control for selection using a technique similar to selection on observables versus unobservables (Altonji, Elder, and Taber, 2005), most of these effects become insignificant.

Gimenez et al. (2013) consider the impact of plausibly exogenous causes of parental death in Taiwan, finding that parental death has a negative effect on educational attainment, coupled with a positive effect on the likelihood of entering the labor force before age 20. Females experiencing a parental death are more likely to marry by age 20, whereas males experiencing a parental death are more likely to enlist in the military within four years of completing secondary school.

Investigating the relationship between parental death and children's occupational status using historical data (1850 to 1952) from the Netherlands, Rosenbaum-Feldbrügge (2019) finds, for both men and women, larger adverse effects due to maternal loss compared to paternal loss in OLS models.[1]

Our paper is most closely related to the recent work by Kristiansen (2021),[2] who examines the effect of parental health shocks, including deaths, on the likelihood of two mental health-related outcomes, therapy and anti-depressant medication. She studies health shocks for children aged 14 to 18 at the time of the shock, using Danish registry data. Based on event study framework, she finds that parental death is associated with short-run increases in both outcomes, with therapy more likely among higher-income families and anti-depressants among lower-income families. In the long run, anti-depressant use is correlated with lower education, whereas no such association is evident for therapy.

[1] Similarly, Dupraz and Ferrara (2021) document a negative effect of paternal death for men whose fathers served in the Union Army during the U.S. Civil War.
[2] Less closely related, but still relevant, is the work by Persson and Rossin-Slater (2018), who report the adverse mental health consequences for children whose mothers experienced a death in the family while pregnant.

Rather than analyze the direct impact of parental death on child outcomes, Kalil et al. (2016) and Gould, Simhon, and Weinberg (2019) investigate how parental death changes the relationship between parental schooling and children's education outcomes in Norway and Israel, respectively. They find that the educational level of the parent who dies becomes less important for children's education outcomes after the parent's death.

Many empirical studies examine the effect of parental death in developing countries of Africa and Asia, including a few that use panel data. An early contribution to this literature is by Case and Ardington (2006), who find adverse effects of parental death on children's educational outcomes in South Africa. Evans and Miguel (2007) find a large, negative association between mother's death and children's primary school participation in Kenya. More recently, Cas et al. (2014) use panel survey data from Indonesia to study the impact of the December 2004 Indian Ocean tsunami on child well-being in Indonesia. Although not a panel, Gertler, Levine, and Ames (2004) use matching techniques to account for the possibility that parental death is not random in Indonesia.

A much larger body of literature on the effects of parental death exists outside economics, using mainly cross-sectional estimation strategies that do not permit causal claims about the estimated relationships. However, reviewing that literature is beyond the scope of the current work. Instead, we highlight recent examples and encourage interested readers to see them and the citations within. In epidemiology, Appel et al. (2013) use a hazard model to estimate the association between parental death and the risk of hospitalization for affective disorders such as bipolar disorder and schizophrenia. They use registry data from Denmark through 2009. A similar study in psychology (Berg, Rostila, and Hjern, 2016) looks at parental loss and depression in Sweden, while McKay et al. (2021) provide a meta-analysis of studies in public health.

We contribute to the literature by analyzing the causal relationship between parental death and multiple measures of the child's mental health. We differ from Kristiansen's (2021) recent analysis of parental death in Denmark that studies therapy and anti-depressant medication as outcomes in four ways. First, we focus on mental health-related hospitalization and estimate separate effects by parent's gender. Second, to identify the explicitly exogenous causes of death, we apply the approach of Espinosa and Evans (2008) and Gimenez et al. (2013), which permits us to estimate the causal effects using deaths not correlated with parental socioeconomic status (i.e., income and education). Third, we provide a second event study analysis, using a difference-in-differences framework, by including a comparison group of individuals without a parental death. Fourth, we test more formally the underlying assumption of parallel trends, using the recent techniques of Borusyak et al. (2021). The event study analysis used here and in Kristiansen (2021) explicitly focuses on how parental death affects mental health over time, in contrast to previous works where the outcome is typically defined at a specific point in time, such as a college entrance exam (Chen, Chen, and Liu, 2009; Gould, Simhon, and Weinberg, 2019).

Administrative datasets

Our empirical analysis is based on nationwide administrative data sources. We start by describing health registers and proceed to characterize the census data. Finally, we describe the outcome variables and provide key descriptive information on parental death.

Health Registers

We use data from the comprehensive death certificates compiled by Statistics Finland to identify the cause and date of death over the period 1970–2016. All diagnoses for the causes of death pass a routine validation conducted by Statistics Finland, and unclear cases are judged by a panel (Lahti and Penttilä, 2001).[3]

The main source of mental health data is the Discharge Register from the Finnish Institute for Health and Welfare, which identifies all inpatient discharges in specialized

[3] The statistics on causes of death include all deaths in Finland or abroad of persons permanently resident in Finland at the time of their death.

public health care for the Finnish population over 1970–2016. Outpatient visits to specialized mental health care facilities are recorded over a shorter period of 1998–2016. In typical cases, several diagnostic procedures have contributed to the diagnosis, including an additional structured clinical interview in some cases. Diagnoses for mental-health disorders are usually established by several treating doctors also. Finland's national health insurance system covers all citizens, with almost all hospitalizations in the public sector, with a very small private Finnish health care system, providing outpatient care principally.

We focus on hospitalization as the main outcome of our analysis for four reasons. First, the treatment costs of mental health-related hospitalizations are considerable in the universal health care system. Second, serious mental illnesses cause considerable indirect economic costs, in terms of weak long-run labor market attachment and lost earnings over the course of life (Hakulinen et al., 2019). Mental disorders are also the leading cause of disability pensions in Finland. Third, the overall reliability of hospitalization data for empirical research is well established and the measurement error very small (Sund, 2012). Fourth, data are available for an extensive period from 1970 onwards, facilitating the use of event study framework to analyze the dynamic effects.

To measure sickness absenteeism, we use total data on sickness absence spells and days over the period 1995–2016. The comprehensive register-based data are from the Social Insurance Institution of Finland (Kela). Information is derived from the database used to pay the sickness allowances to the affected persons. Sickness absences are diagnosed by a physician (i.e., general physicians, occupational physicians, and psychiatrists). Before receiving the sickness allowance from Kela, the person must complete a nine-day waiting period. The incapacity for work must be certified by a doctor, and the employer is obliged to notify Kela of the sickness leave. The employee is entitled to the normal, full salary during the nine-day waiting period (for a detailed description of the Finnish sickness insurance system, see Böckerman et al., 2018). Thus, due to the institutional character of the system, the data recorded by Kela contain sickness absence spells lasting longer than nine days. The medical reason for sickness leave is comprehensively recorded for the period 2004–2016, allowing us to identify mental health-related sickness leaves.

To capture mild mental health-related disorders that do not lead to hospitalization, we utilize data from the Social Insurance Institution of Finland containing filled mental health-related medications dispensed at Finnish pharmacies over 1995–2016. These medications are listed in the World Health Organization (WHO)'s anatomical therapeutic chemical (ATC) classification system as codes beginning with 'N05', 'N06A', 'N06B' or 'N06C'. As anti-depressants are the first choice of treatment in moderate and severe depression cases in Finland based on the clinical guidelines, including the use of mental health-related medications in the set of outcomes also captures individuals who are not treated in hospital or outpatient clinics and who did not need sick absence leave due to their depression or other mental disorder. The data record the universe of individual-level prescriptions reimbursed under comprehensive national health insurance scheme. All permanent residents of Finland are automatically covered under the national health insurance. The use of comprehensive register-based data allows us to follow patients over time, even in cases where patients switch physicians or employers. We create an indicator of having at least one prescription for mental health-related disorders per year.

Census Data

These health registers are linked to the census data on the population of Finland, available from Statistics Finland. The census files are available at five-year intervals from 1970 to 1985 and annually from 1987 to 2016 and provide comprehensive information on the parents and their children, including data on family composition, education, earnings, occupation, and the region of residence.

Given that Finland has a current population of approximately 5.5 million, we use data for an extended time period, for both parents and children, to improve the precision of the estimates. Specifically, we follow Finnish individuals born between 1971 and 1986, by which we have data on approximately one million individuals who have reached at least the age of 30 (in 2016). We exclude children born outside Finland and those who have no data for either parent.

Outcome Variables

With these linked data,[4] we analyze several outcome variables. Event study framework requires observations over a long time to identify the dynamic adjustment to parental death. Therefore, our main outcome of analysis using an event study approach describes whether an individual had at least one (in-patient) hospitalization spell annually due to mental health-related disorders (ICD-10: F, ICD-8 and ICD-9: 290–319). To obtain a comprehensive picture, we also examine selected conditions related to i) depression, ii) anxiety, and iii) substance-use disorder. Further, we study effects on hospitalizations due to self-harm (including suicide attempts). In the hospitalization records, self-harm attempts (ICD-10: X60–X84, ICD-8 and ICD-9: E950–E959) are recorded as independent, external causes of hospitalization (i.e., not all self-harming attempts are coded as mental health disorders). Of self-harming attempts that lead to hospitalization, mental health disorder is recorded as the principal cause of hospitalization in approximately 10% of the cases.

In the cross-sectional analysis, we utilize several other outcomes such as a broader measure of mental health-related deaths, sickness absence, employment, and earnings in adulthood, for which we do not have observations over the long period that would allow us to examine the dynamic effects using event study framework. Following Alexander and Schnell (2019), we analyze a broader measure of mental health-related deaths as additional outcome. The measure includes not only officially recorded suicides in death certificates, but also injuries of undetermined intent (i.e., fatal injuries unascertainable as to whether they were

[4] As the linkage between data sources is done based on a unique person identifier akin to the Social Security number in the U.S., the data – as in other Nordic countries – are of very high quality.

accidental or purposely inflicted), and accidental deaths involving poisonings, drownings, and deaths involving firearms and trains. We prefer this more comprehensive measure of mental health-related deaths to suicides, because all deaths caused by mental health-related disorders are not necessarily classified officially as suicides in the register data.

In addition to the hospital spells in inpatient care, we also observe whether individuals had day visits to special care units related to mental health disorders at ages 27–30. We further measure the number of sickness absence days (ages 26–30), whether they have sickness absence spells due to mental health reasons (age 30) and whether they use mental health-related medications (ages 29–30).To analyze the potential mechanisms at play, we analyze the effects on children's employment and earnings (at ages 26–30), based on comprehensive information from the Finnish tax authorities, and years of schooling (by age 30), based on register-based information on completed degrees available from Statistics Finland since 1970.

Descriptive Information on Parental Death

Nearly 15 percent of individuals experience a parental death before they turn 31 (Table 1). Less than five percent of them experience the death of their mother, compared to nearly 12 percent for the death of the father. For either parent, the likelihood of death increases substantially with the individual's age, from under one percent for a parental death before age 10 to 4.64 percent when the individual is between 26 and 30 years old.

Table 1: Age of Individual upon Parent's Death

Age when	Death of Mother		Death of Father		Death of Parent	
Parent Died	Freq.	Percent	Freq.	Percent	Freq.	Percent
Age 0–2	714	0.07	2,819	0.30	3,513	0.36
3–6	1,595	0.17	5,802	0.61	7,332	0.76
7–10	2,573	0.27	8,093	0.85	10,496	1.09
11–15	4,853	0.51	14,109	1.49	18,500	1.92
16–20	7,378	0.77	19,728	2.08	26,059	2.70
21–25	10,434	1.09	26,633	2.81	34,898	3.62
26–30	14,293	1.49	35,096	3.70	45,212	4.69
No death by age 30	917,778	95.64	836,725	88.17	818,923	84.87
Total	959,618	100.0	949,005	100.0	964,933	100.0

Notes: Number of observations is smaller for fathers because it is more common that the link between parent and child is missing for father (1.7%) than mother (0.6%).

Methods

Event Study Specifications

To allow the relationship between parental death and children's mental health outcomes to vary with the time since death, our main results are based on an event study specification, analogous to the model estimated by Kleven et al. (2019) for the effect of children on gender inequality. This approach allows the analysis of dynamics and adaptation to the shock with an emphasis on the length of the effects detected on mental health.

Equation (1) depicts the event study specification:

$$Y_{ist} = \sum_{j\neq -1} \alpha_j \cdot I[t = j] + \sum_k \beta_k \cdot I[age_{is} = k] + \sum_y \tau_y \cdot I[s = y] + \varepsilon_{ist} \qquad (1)$$

The preferred measure of Y_{ist} is a dummy variable that equals to one for person *i* being hospitalized for a mental health-related condition at age s in time t (year relative to parental death).[5] The right-hand side of the equation captures the events through a series of indicators (or dummy variables) for each of the three different aspects of the event. The first set of coefficients (α_j) captures the effect of the parental death at time $t = j$. Specifically, we include fixed effects for each year from eight years before the parental death until ten years

[5] See Figure A1 in the Supplementary Appendix for the development of hospitalization rates before and after the parental death in the treatment groups.

after the parental death. The second set of coefficients (β_k) controls for the effects of the age of the child on mental health outcomes. Finally, the third set of coefficients (τ_y) accounts for calendar year effects. To capture the potential heterogeneity in the effects, we estimate separate event study models for male and female children, as well as for maternal and paternal death.

This event study model is estimated only for individuals who had a parental death. In fact, to allow for effects up to eight years prior to and ten years after the parental death, the sample for the event study models is limited to individuals who were 10 to 20 when a parent died.[6] To infer a causal effect from an event study model, children who are treated at different ages should have similar trends in pre-parental-death hospitalization. Following Borusyak et al. (2021), we examine this key identification assumption by conducting formal statistical tests of the pre-parental-death trends by using data from the pre-treatment periods. The results reported in Appendix B do not show evidence of significant pre-trends (based on individual t-tests or a joint significance F-test; see Table B1).

Our second model is a difference-in-differences event study specification, again following the estimation technique of Kleven et al. (2019). Specifically, we create a control group of individuals who did not experience a parental death by assigning pseudo death years for their father (and mother) in such a way that it follows the same (conditional) discrete distribution (for the age of death) as deaths in the treatment group.[7] Separate event study regressions, as described in equation (1), are estimated for the treatment and control groups, in addition to separate models by parental death and gender of the child. Here, the assumptions required for causality are that the trends in pre-parental-death hospitalization are similar between children who experienced a parental death and those who did not. This

[6] In Kristiansen (2021), the age range is 14 to 18, and the time period is from four years prior to and five years after the parental health shock.

[7] Note that Kleven et al. (2019) use log-normal distribution for the births; but we cannot use it here, because the deaths are clearly not following normal or log distribution (when the child is 20 or under).

assumption is supported by Tables B1 and B2 that do not show evidence for significant pre-trends in the treatment or control group.

We also examine the robustness of our baseline results using the imputation estimator proposed by Borusyak et al. (2021).[8] Contrary to fixed effects regression with lags and leads of treatment, the coefficients from the imputation estimator are robust in the presence of heterogeneous treatment effects (see Appendix B).

An additional concern regarding the causal interpretation of our baseline estimates is that some causes of death are arguably more exogenous than others. For instance, medical literature has shown that cardiovascular diseases are strongly correlated with socioeconomic status (SES), a lower SES being significantly associated with higher cardiovascular risk (Tousoulis et al., 2020). To identity the explicitly exogenous causes of death, we use the approach introduced in Espinosa and Evans (2008) and adopted later in Gimenez et al. (2013). The basic idea of this approach is to classify the causes of death into two groups: i) deaths strongly correlated with measures of parental socioeconomic status (i.e., informative causes of death) and ii) deaths driven by likely random causes and not correlated with socioeconomic status (i.e., uninformative causes of death). This classification implies that uninformative causes of death are, by construction, unrelated to parental socioeconomic characteristics and provide a clean source of exogenous variation in parental death. Thus, to check the robustness of our baseline findings, we estimate event study models separately for uninformative and informative causes of death. The empirical implementation of this approach is described in Appendix C.

Cross-Sectional Specifications

As some outcomes are available only in adulthood, we also present descriptive results based on a cross-sectional ordinary least squares (OLS) regression, as in Rosenbaum-Feldbrügge (2019):

[8] See von Bismarck-Osten et al. (2020) for an application of the method.

$$Y_i = F_i\alpha_f + M_i\alpha_m + X_i\beta + \varepsilon_i \tag{2}$$

As before, the preferred outcome (Y_i) is a dummy variable that equals one for individuals ever hospitalized for a mental health-related condition at ages 26–30. Here, F_i and M_i represent a set of dummy variables for different ages of death (0–6, 7–10, 11–15, 16–20, 21–25, or 26–30) for the father (F) and mother (M), respectively. The comparison group is the set of individuals who did not experience a parental death by age 30. X_i is a set of control variables including mother's and father's education, income, occupation and mental health, native language, mother's age at childbirth, number of siblings, as well as birth year and birth region fixed effects.[9]

Controlling for parental education and income is important because socioeconomic status (SES) is correlated with longevity, i.e., children with lower SES parents are more likely to lose them early. A strong identifying assumption in this model is that the set of control variables (X_i) captures all the underlying differences between children with a parental death and children without a parental death. In a robustness test, we also report the main cross-sectional results for the uninformative causes of death, where the identifying assumptions are more likely to hold.

The major difference between the baseline event study model and cross-sectional model is that the event study model compares hospitalization rates (within-person) before and after parental death. In contrast, the cross-sectional model compares hospitalization rates at ages 26–30 between individuals who experience parental death at different ages. In other words, the event study model represents the timing of the short-term impact, whereas the cross-sectional model represents the cumulative, long-run impact. This difference in timing and the different underlying identification assumptions preclude any direct comparison of the results from the two estimation techniques.

[9] Appendix Table D1 provides descriptive statistics at the individual level, separately by parental death. Strikingly, the rate of hospitalization for mental health-related reasons at ages 26–30 is 2.0 percent for individuals with no parental death by age 30, compared to rates of 3.3-3.7 percent for individuals with a parental death by age 30.

For both the event studies and the cross-sectional regressions, all results are based on linear probability models, even though the preferred outcome is binary. These models facilitate the easier interpretation of the estimated coefficients and are also less sensitive to distributional assumptions.

Results

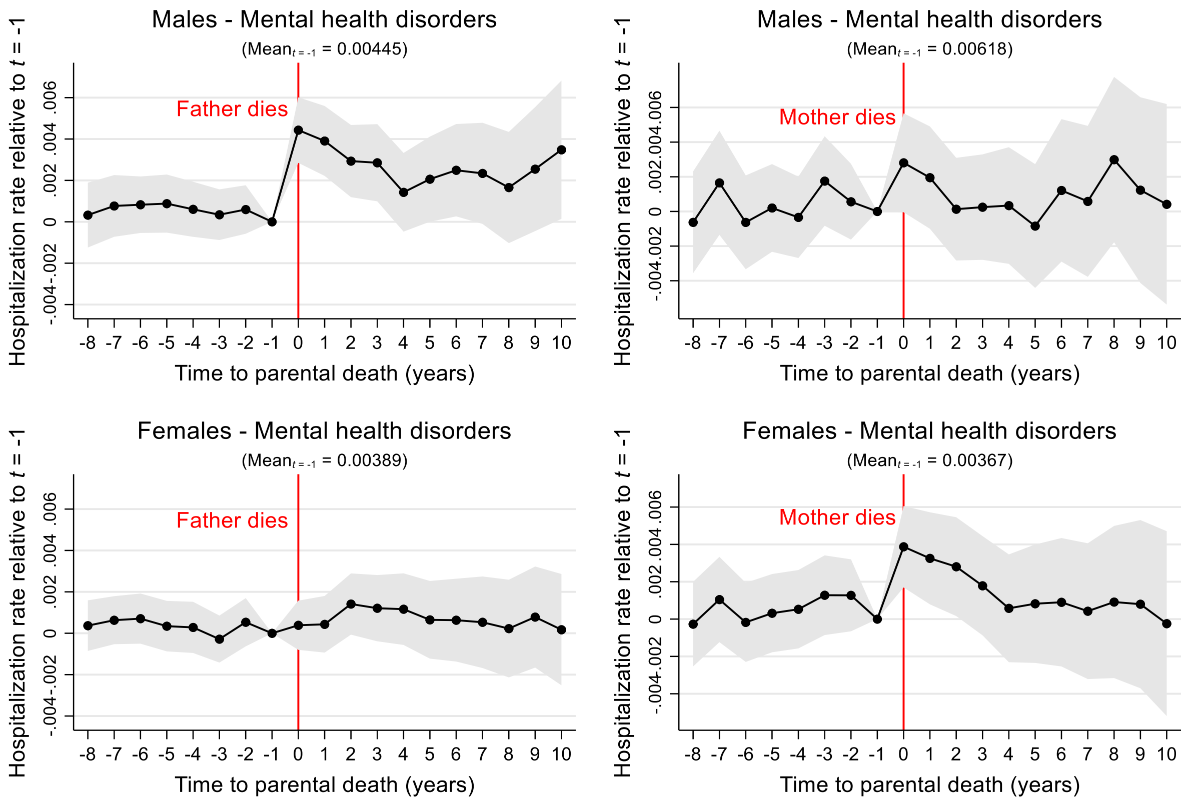
Main Results: Event Study Estimates

We start our analysis by presenting the estimates from our event study model based on equation (1). The results from this model are shown in Figure 1 and Table A1. This model uses panel data for individuals who had a parental death when they were between 10 and 20 years, with yearly observations from eight years before the death up to ten years after the death (i.e., up to 19 observations per person). The dependent variable is a dummy variable equal to one for individuals who are hospitalized with a mental health condition in the year. The reference period is the year prior to parental death, when the average hospitalization rate was between 0.004 and 0.006. The figure plots the change in likelihood of hospitalization relative to the year before the parental death.

Figure 1 shows that males and females have a large increase of 0.004 in the likelihood of hospitalization for mental health conditions in the year the parent of the same gender dies, compared to the year prior to the parental death. For females, this effect declines quickly to 0.0028 and 0.0024 in the next two years. Thereafter, the coefficients are not statistically significant from zero at the ten-percent level for a two-sided test. For males, the coefficients for paternal death decline more slowly, with a statistically significant effect of 0.0030 three years after the death. Of the 11 coefficients for zero to ten years after the death, five are significant at the one-percent level, three at the five-percent level, two at the ten-percent level, and one is not statistically significant at the ten-percent level (all tests are two-sided).

In other words, the effect of a paternal death for a male aged 10 to 20 is strongest in the short term, but sizable effects persist in the long term, too.

Figure 1: Event Study Results Using Hospitalization for Males and Females



Notes: The figures plot the coefficient estimates from event study regressions, together with 95% confidence intervals (standard errors clustered at the individual level). The outcome is the hospitalization rate. Panels on the left show estimates for father's death and those on the right show them for mother's death.

By comparison, the effect of a parent of a different gender dying is much smaller. For males, the effect of a maternal death is 0.0026 and marginally significant in the year of the death, followed by a statistically insignificant coefficient of 0.0020 in the year after the death. After that, the coefficients are generally close to zero and are never statistically significant at the ten-percent level. None of the coefficients for females experiencing paternal death are statistically significant at the ten-percent level, and only two of them are above 0.001 in magnitude.

Past work focusing on educational and labor-market outcomes has generally found that the largest effects are for maternal death (Rosenbaum-Feldbrügge, 2019; Chen, Chen, and Liu, 2009). Although we find short-term effects of maternal death for females, our largest (cumulative) effects on mental health are for males experiencing a paternal death. This result is broadly consistent with the lower probability of marriage among males experiencing a paternal death found by Lang and Zagorsky (2001), as well as larger negative effects of paternal death on non-cognitive outcomes in Adda, Björklund, and Holmlund (2011).

Non-economic literature is also helpful for the interpretation of the pattern. A plausible explanation for the observation that the death of a parent of a different gender has smaller effects on hospitalization is that emotional attachment is stronger if the parent and child have the same sex. For example, psychological literature has provided evidence that fathers tend to spend more shared time with their sons than with daughters (Raley and Bianchi, 2006). However, we cannot identity the direct mechanisms at play in our empirical setting, because the register data are not well suitable for the examination of social interactions and the degree of emotional attachment within families.

Next, we check the robustness of the baseline event study results to alternative specifications. Tables A2a–A2b report the results for our baseline event study model (columns 1 and 4), a specification with the addition of individual fixed effects (columns 2 and 5), and a model with the additional control variables as in the cross-sectional model (columns 3 and 6). The tables show that all the results are quite consistent across these three models for males.[10] Similarly, Figure B1 shows the similarity of results when using the imputation estimator proposed by Borusyak et al. (2021), a more flexible event study framework allowing for heterogeneous treatment effects.

[10] A minor exception to this pattern is that, for females, the coefficients for father's death are statistically significant in one of the three models. We adopt a conservative attitude in the interpretation of the results and conclude that there is no consistent relationship between father's death and daughter's mental health outcomes, a result in agreement with the insignificant results for mother's death and son's mental health outcomes.

Tables A3a–A3d present results by cause of hospitalization (see also Figures A2a, A2b, A3). In each table, the first column reports the result from Table A1 for all causes, and the remaining columns present the results for a specific cause of hospitalization: (2) depression, (3) anxiety, (4) substance abuse and (5) intentional self-harm (incl. suicide attempts).[11] For males experiencing a paternal death, the coefficients are largest for depression in the short term and for anxiety in the long term. For males experiencing a maternal death, the results are inclusive: the estimated post-parental-death coefficients are imprecise, and several pre-parental-death coefficients for anxiety are marginally significant.

For females, the most pronounced effects for maternal death are associated with intentional self-harm and depression. At the same time, there are marginally significant effects six to seven years before the death, suggesting some caution in attributing much emphasis to the post-death effects. For females experiencing a paternal death, the estimated coefficients are mostly small and statistically insignificant. As these hospitalization outcomes are quite rare, and some pre-parental-death coefficients are statistically significant, the results in Tables A3a–A3d should be interpreted as suggestive, rather than conclusive.[12]

Our second model is a difference-in-differences event study, where we compare individuals with a parental death to a control group of individuals without a parental death, using the event study framework. Figure 2 illustrates the results from these models for males and females, separately. For each figure, the top panel compares individuals with a paternal death to individuals of the same gender without a paternal death, whereas the bottom panel is for maternal deaths. Each line is the coefficient from a separate event study regression, unlike a more traditional difference-in-differences model with an interaction between the two 'differences'. Tables A4a–A4b report the regression results for males and females,

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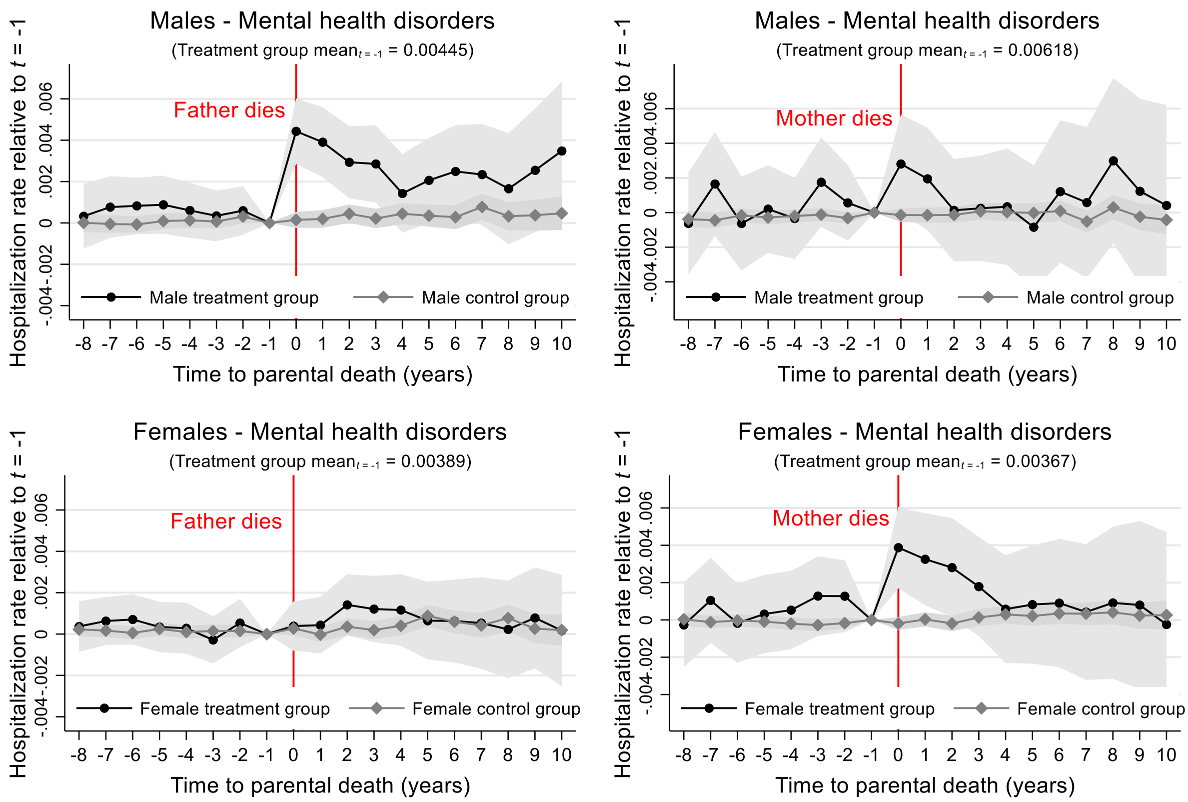
[11] This list is not exhaustive. For space considerations, we have not included results for schizophrenia or other rare mental health conditions. The prevalence of schizophrenia is also very low, making it difficult to identify statistically significant effects; further, it is largely driven by genetic factors.

[12] Similarly, we do not include results by subgroups like age at parental death, due to small samples and noisy estimates.

respectively. Again, the reported effects are the change in the hospitalization rates relative to the year before parental death.

The results in Figure 2 display the same basic pattern as the single difference event study models in Figure 1. Males who experience a paternal death have a drastic increase in the likelihood of hospitalization in the year of the death and the following three years, and this difference is statistically different from the hospitalization pattern for males who did not experience a paternal death. Otherwise, any increase in hospitalization due to parental death – maternal or paternal – is indistinguishable from the control group.

Figure 2: Difference-in-Differences Event Study Results for Males and Females



Notes: The figures plot the coefficient estimates from difference-in-differences event study regressions, together with 95% confidence intervals (standard errors clustered at the individual level). The outcome is the hospitalization rate.

With respect to females, we can never distinguish the difference in hospitalization between those experiencing a paternal death and others, similar to previous models. We detect a noticeably higher likelihood of hospitalization in the year of a maternal death and the following year. However, by year 2, the standard error of the treatment group coefficient is so wide that we cannot rule out the possibility (at the 95-percent confidence interval) that the likelihood of hospitalization is the same for the treatment and control groups. This finding, coupled with a similar result for 4 or more years after experiencing a paternal death for males, is the only instance where the event study (Figure 1) and the difference-in-differences event study (Figure 2) differ.

In brief, both event study specifications show that individuals who experience the death of a parent of the same gender have dramatically higher hospitalization rates, nearly equal to the mean hospitalization rate for the treatment group, in the year of the parental death and the following year. The effect persists slightly longer for males, but by four years after the parental death, we cannot detect any significant differences in the coefficients between the treatment and control groups.[13]

Finally, we estimate event study specifications separately for uninformative and informative causes of death (Figure 3).[14] The assumption of parallel trends should hold for uninformative causes of death because, by construction, they are unrelated to parental characteristics. These results reveal two key findings. First, we observe that our baseline conclusions remain intact using only uninformative causes of death that are likely driven by random causes.[15] Second, we find that the effects on hospitalization tend to be quantitatively larger using uninformative causes of death, *vis-a-vis* informative causes of death. This finding is plausible, because children are likely to face greater immediate shock after the incidence of uninformative causes of death that are independent from the socioeconomic characteristics of the family.

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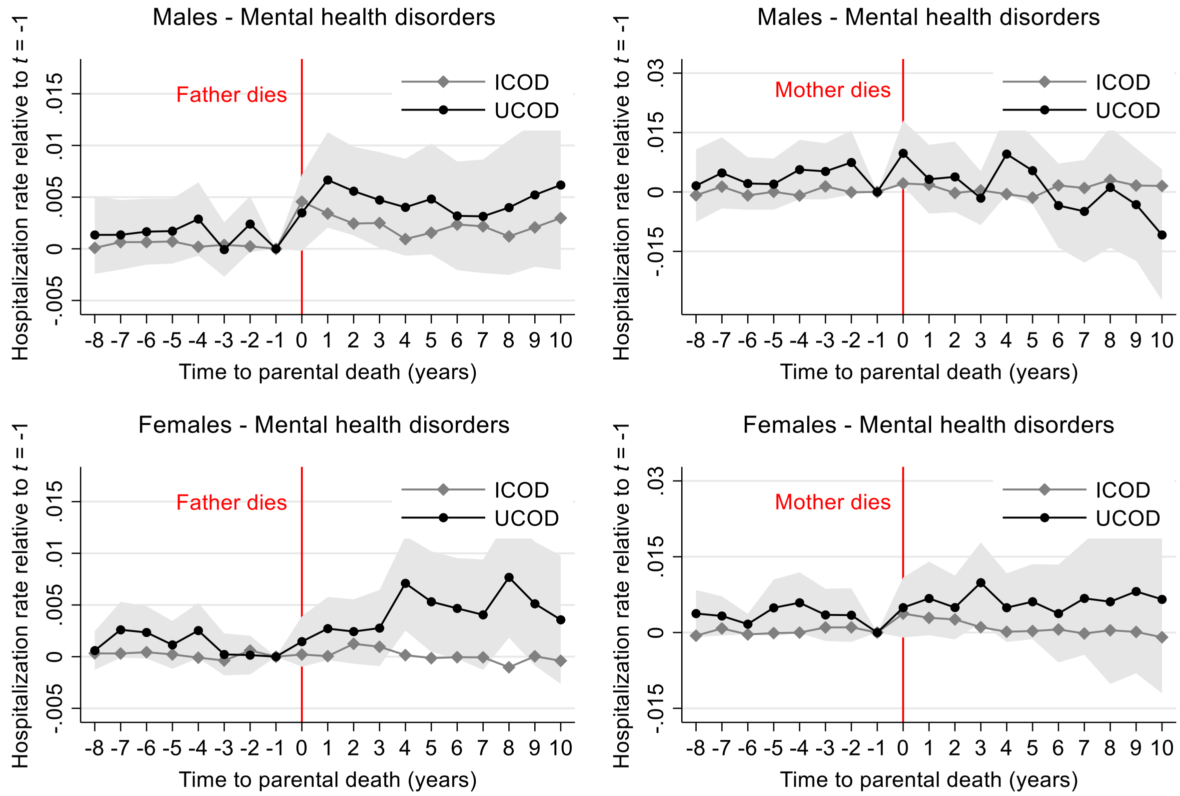
[13] These conclusions also hold when we use the imputation estimator for the treatment and control groups (Figures B1 and B2).

[14] See Appendix C for the empirical results on the classification of deaths into UCODs and ICODs, based on the technique in Gimenez et al. (2013).

[15] For females, the effect of maternal death is positive, but no longer significant due to low number of maternal UCODs.

Figure 3: Event Study Coefficients for Hospitalization, ICOD vs. UCOD of a Parent, Males and Females



Notes: The figures plot the coefficient estimates from event study regressions. The outcome is the hospitalization rate. Models were run separately for informative and uninformative parental deaths (ICOD vs UCOD). For clarity, only 95% confidence intervals are shown for the UCODs (standard errors clustered at the individual level).

Cross-Sectional Estimates

Next, we turn to results from the cross-sectional model estimated using equation (2) for the pooled sample of individuals with and without a parental death. This model provides a longer-term perspective on the association of outcomes with parental death, complementing the in-depth analysis of the short-term outcomes in the event study analysis. The results are based on a linear probability model, where we account for age and year fixed effects, along with extensive demographic control variables (see equation 2).

First, we present results for the baseline dependent variable that equals one for individuals who were hospitalized for a mental health-related condition between the ages of 26 and 30. These results are reported in columns 2 and 4 in Table D2 and Figure D1; see also

Figures 4a and 4b. The most striking result is that the parental death variables are often large and statistically significant, regardless of the gender of the child or the parent. In other words, the short-run pattern, from the event studies, where coefficients are the largest for the death of the parent of the same gender, is not present in the long-run, cumulative analysis using cross-sectional data. The coefficients are usually larger for males than females. When comparing the effects at different ages of parental deaths, we observe more similarities than differences either for males (left panel) or females (right panel).[16]

To obtain a more comprehensive picture of the health effects, we proceed to analyze the relationship between parental death and several additional cross-sectional outcomes that can be measured only in adulthood. The results, shown in Figures 4a and 4b, are based on the same cross-sectional model (equation 2). An event study approach, based on pre- and post-death outcomes, is not appropriate for outcomes that are not relevant for children, such as work-related absences.

The overall hospitalization measure used in our main estimation results does not capture mild mental health-related problems not requiring hospitalization in specialized public health care. For this reason, we examine separately the relationship between parental death and the use of mental health-related medications at ages 29–30. We find a significant increase in the use of mental health-related medications after parental death, for both males and females. The effect among both genders is interesting for two reasons. First, the use of mental health-related medications is more common among females in the population. Second, the increase in the use of mental health-related medications does not eliminate the appearance of serious mental health-related problems captured by the hospitalization measure.

The results also show a substantial increase in mental health-related deaths at ages 26–30 for males due to maternal death. Further, we observe an increase in sickness absence days at ages 26–30 after parental death prevailing among both the genders. The quantitative

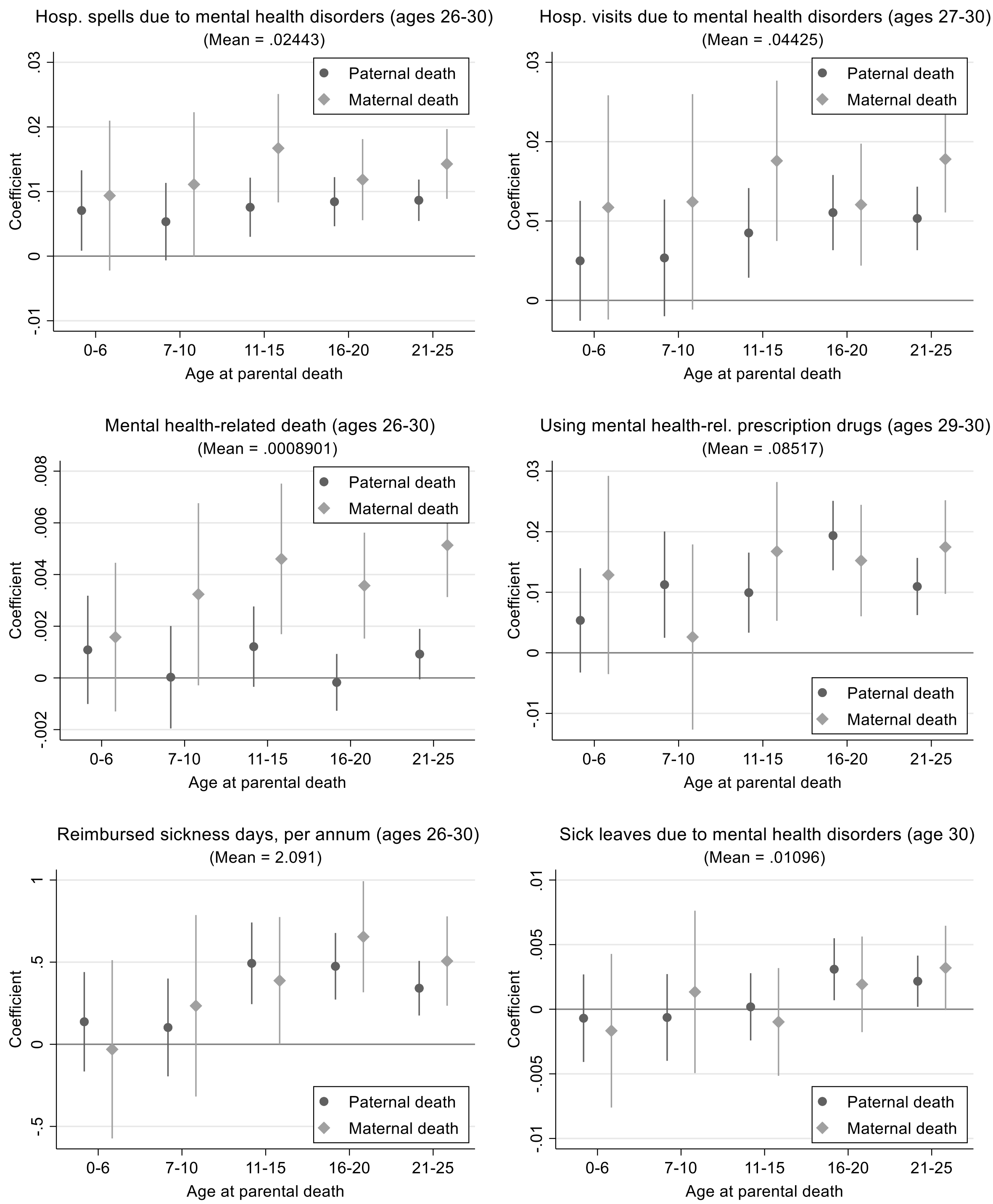
[16] The results for uninformative causes of deaths are similar (see Figure C1).

size of the effect is larger for females. There is also an increase in sickness absence days due to mental health-related reasons for both genders at age 30.

Finally, using register-based data, we study whether broad economic outcomes in adulthood are negatively affected by parental death. We find that there are substantial negative effects on education (measured by years of schooling), annual earnings at ages 26–30 and employment, for both females and males (Figure D2). These effects are not notably different due to paternal or maternal death. The effects on two key labor market outcomes (i.e., earnings and employment) are larger for males. These significant negative effects on income level and socio-economic status in adulthood could partially lead to poor mental health.

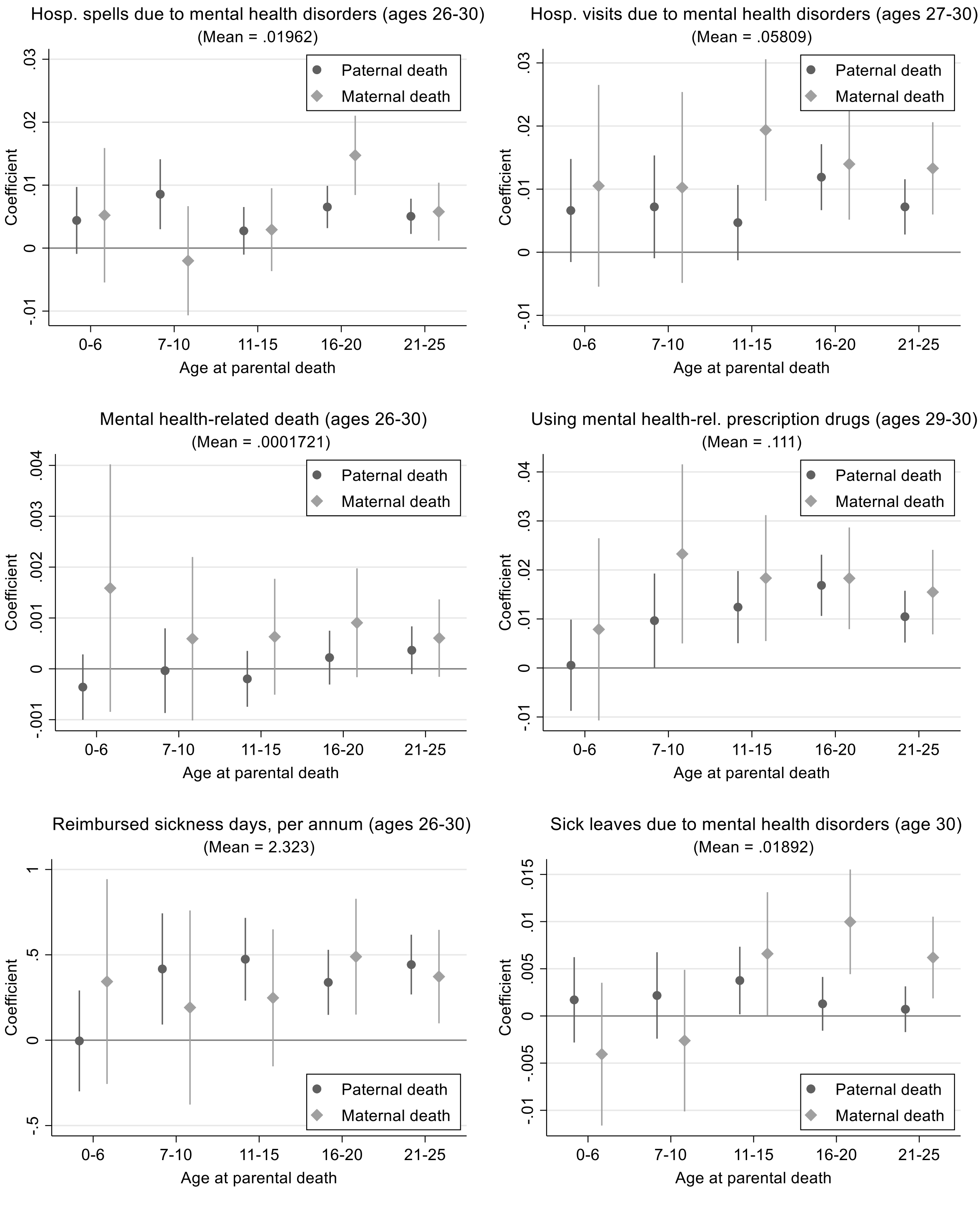
Although informative, these cross-sectional results – particularly for death at later ages – are best viewed as descriptive for two reasons. First, the models control only for non-random variation in parental death through the inclusion of control variables (X_i). In this model, for example, the hospitalization outcomes could have taken place before the parental death and therefore not be causal. Second, we cannot distinguish whether the smaller coefficients for later parental deaths are because the impact of the death is smaller at later ages or because the individual has fewer years after the parental death to be hospitalized, although both explanations are plausible.

Figure 4a: Cross-Sectional Linear Probability Model, Alternate Health Outcomes, Males



Notes: Figure reports coefficient estimates together with 95% confidence intervals based on robust standard errors. Model specification is the same as in Appendix Table D2 (with controls). Comparison group is children born in 1971–86 without parental death by age 30.

Figure 4b: Cross-Sectional Linear Probability Model, Alternate Health Outcomes, Females



Notes: Figure reports coefficient estimates together with 95% confidence intervals based on robust standard errors. Model specification is the same as in Appendix Table D2 (with controls). Comparison group is children born in 1971–86 without parental death by age 30.

Conclusions

Parental death is a traumatic life event which has major impacts on many life domains. We provide new evidence on the effect of parental death on mental health outcomes, with a focus on mental health-related hospitalization. Given the empirical literature in other disciplines on the adverse effects of parental death on mental health, our analysis is a starting point for economists.

Using nationwide register-based data, our results extend the empirical literature in several ways. We find robust evidence that parental death has the most adverse outcomes when males experience a paternal death. The likelihood of hospitalization for mental health reasons roughly doubles – from a very low base of less than 0.01 – in the year of death, and the effect is large and significant in the following 2–3 years (depending on the model). In some specifications, the effect lingers on for most of the 10 year-period we study following death. Females experiencing a maternal death also have a near doubling of the (very low) likelihood of hospitalization in the year of death and the following year. In contrast, we generally cannot reject the possibility of no change in hospitalization rates for males experiencing maternal death or females experiencing paternal death.

These main findings are robust across four different model specifications. To understand the impacts, our preferred specification is an event study model based on Kleven et al. (2019) and Kristiansen (2021), where we explicitly model the dynamic effect of parental death over time. As the event study model includes only individuals experiencing a parental death, we also specify a difference-in-differences event study model using individuals without a parental death before age 30 as a comparison group. As in Kleven et al. (2019), the results from the two event study models are quite similar. Finally, we present results based on a cross-sectional linear probability model with age effects, along with an extensive set of controls for demographic and parental characteristics.

Using the cross-sectional model specification, we provide further evidence to document significant increases in the use of mental health-related medications and sickness absence, as well as substantial reductions in years of schooling, employment, and earnings for the affected children in adulthood. The education and labor market losses add substantially to the mental health burden caused by parental death. It is worth emphasizing that we cannot offer a causal interpretation for the results based on cross-sectional model specification.

In general, our results are broadly consistent with the economics literature on parental death, the focus of which is on educational and labor-market outcomes, tending to find stronger effects for maternal death rather than paternal death. Our results for females experiencing a maternal death show a consistency between mental health outcomes and educational and labor-market outcomes. Although the economics literature does not find strong effects for paternal death, even among males, for educational and labor-market outcomes, past work has found a relationship between paternal death and other outcomes such as marriage (Lang and Zargosky, 2001) and psychological profile and health (Adda, Björklund, and Holmlund, 2011). Taken collectively, the literature suggests that parental death has a heterogeneous effect on a diverse set of economic outcomes.

Our findings can be used to provide practical guidance for policy setting. Since parental death leads to substantial negative effects on mental health and to significant labor market losses, policy makers should pay special attention to the allocation of appropriate resources to interventions aimed at mitigating these effects. Many of the interventions (e.g., provision of effective mental health services like therapy) would need to occur in schools.

Still, numerous questions concerning parental health and children's outcomes remain unanswered. The event study method used here illustrates the short-run and medium-run outcomes year-by-year, but requires substantial assumptions about exogeneity. These concerns are mitigated to some degree by the similarity of results across three dimensions: (1) between models with and without control variables, (2) with and without a control group of individuals who did not experience a parental death, and (3) restricted to plausibly exogenous causes of death that are not correlated with socioeconomic characteristics, as in Espinosa and Evans (2008) and Gimenez et al. (2013). Since parental death is a rare event, and the population of Finland – and other northern European countries with detailed registry data – is moderate, most subgroup analyses are imprecise. Deeper understanding of the heterogeneous effects of parental death on mental health is an important topic for future empirical research.

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SUPPLEMENTARY ONLINE APPENDIX (NOT FOR PRINT)

CONTENT

- Appendix A. Tables and Figures: Event Study Design
- Appendix B. Pre-Trend and Imputation Estimation Results
- Appendix C. Uninformative vs. Informative Parental Deaths
- Appendix D. Tables and Figures: Cross-Sectional Analysis

APPENDIX A. TABLES AND FIGURES: EVENT STUDY DESIGN

Table A1: Event Study Coefficients for Hospitalization, By Gender of Individual and by Parental Death

	Males, Father (1)	Males, Mother (2)	Females, Father (3)	Females, Mother (4)
8 years before death	0.0003	-0.0006	0.0004	-0.0003
	(0.0008)	(0.0015)	(0.0006)	(0.0012)
7 years before death	0.0008	0.0017	0.0006	0.0010
	(0.0008)	(0.0015)	(0.0006)	(0.0012)
6 years before death	0.0008	-0.0006	0.0007	-0.0002
	(0.0007)	(0.0014)	(0.0006)	(0.0011)
5 years before death	0.0009	0.0002	0.0003	0.0003
	(0.0007)	(0.0013)	(0.0006)	(0.0011)
4 years before death	0.0006	-0.0003	0.0003	0.0005
	(0.0007)	(0.0012)	(0.0006)	(0.0011)
3 years before death	0.0003	0.0018	-0.0003	0.0013
	(0.0006)	(0.0013)	(0.0006)	(0.0011)
2 years before death	0.0006	0.0006	0.0005	0.0013
	(0.0006)	(0.0011)	(0.0006)	(0.0010)
Year of death	0.0044***	0.0028*	0.0004	0.0039***
	(0.0008)	(0.0015)	(0.0006)	(0.0011)
1 year after death	0.0039***	0.0020	0.0004	0.0033***
	(0.0009)	(0.0015)	(0.0007)	(0.0013)
2 years after death	0.0029***	0.0001	0.0014*	0.0028**
	(0.0009)	(0.0015)	(0.0008)	(0.0014)
3 years after death	0.0029***	0.0002	0.0012	0.0018
	(0.0010)	(0.0016)	(0.0008)	(0.0014)
4 years after death	0.0014	0.0003	0.0012	0.0006
	(0.0010)	(0.0017)	(0.0009)	(0.0015)
5 years after death	0.0021**	-0.0008	0.0007	0.0008
	(0.0010)	(0.0018)	(0.0010)	(0.0016)
6 years after death	0.0025**	0.0012	0.0006	0.0009
	(0.0011)	(0.0021)	(0.0010)	(0.0018)
7 years after death	0.0023*	0.0006	0.0005	0.0004
	(0.0012)	(0.0022)	(0.0011)	(0.0019)
8 years after death	0.0017	0.0030	0.0002	0.0009
	(0.0014)	(0.0024)	(0.0012)	(0.0021)
9 years after death	0.0025*	0.0012	0.0008	0.0008
	(0.0015)	(0.0027)	(0.0012)	(0.0023)
10 years after death	0.0035**	0.0004	0.0002	-0.0002
	(0.0017)	(0.0030)	(0.0014)	(0.0025)
Observations	343,600	125,187	334,878	118,081
Number of individuals	18,272	6,676	17,798	6,299
R-squared	0.0038	0.0044	0.0028	0.0037
Age fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Individual fixed effects	NO	NO	NO	NO
Additional controls	NO	NO	NO	NO
Mean $Y_{t=-1}$	0.0045	0.0062	0.0039	0.0037

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20.

Table A2a: Alternate Event Study Models, By Parental Death, Males

	Father (1)	Father (2)	Father (3)	Mother (4)	Mother (5)	Mother (6)
8 years before death	0.0003	-0.0015	0.0007	-0.0006	-0.0032	0.0006
	(0.0008)	(0.0016)	(0.0008)	(0.0015)	(0.0028)	(0.0015)
7 years before death	0.0008	-0.0008	0.0012	0.0017	-0.0005	0.0027*
	(0.0008)	(0.0015)	(0.0008)	(0.0015)	(0.0025)	(0.0015)
6 years before death	0.0008	-0.0004	0.0012*	-0.0006	-0.0023	0.0002
	(0.0007)	(0.0013)	(0.0007)	(0.0014)	(0.0023)	(0.0014)
5 years before death	0.0009	-0.0001	0.0012*	0.0002	-0.0011	0.0009
	(0.0007)	(0.0011)	(0.0007)	(0.0013)	(0.0019)	(0.0013)
4 years before death	0.0006	-0.0002	0.0006	-0.0003	-0.0013	0.0002
	(0.0007)	(0.0010)	(0.0007)	(0.0012)	(0.0016)	(0.0012)
3 years before death	0.0003	-0.0002	0.0003	0.0018	0.0011	0.0021
	(0.0006)	(0.0008)	(0.0006)	(0.0013)	(0.0015)	(0.0013)
2 years before death	0.0006	0.0003	0.0006	0.0006	0.0002	0.0007
	(0.0006)	(0.0007)	(0.0006)	(0.0011)	(0.0012)	(0.0011)
Year of death	0.0044***	0.0047***	0.0042***	0.0028*	0.0031**	0.0026*
	(0.0008)	(0.0009)	(0.0008)	(0.0015)	(0.0016)	(0.0015)
1 year after death	0.0039***	0.0045***	0.0036***	0.0020	0.0026	0.0016
	(0.0009)	(0.0010)	(0.0009)	(0.0015)	(0.0017)	(0.0015)
2 years after death	0.0029***	0.0038***	0.0024***	0.0001	0.0012	-0.0004
	(0.0009)	(0.0011)	(0.0009)	(0.0015)	(0.0020)	(0.0015)
3 years after death	0.0029***	0.0040***	0.0026***	0.0002	0.0017	-0.0004
	(0.0010)	(0.0012)	(0.0010)	(0.0016)	(0.0023)	(0.0016)
4 years after death	0.0014	0.0028**	0.0012	0.0003	0.0021	-0.0005
	(0.0010)	(0.0014)	(0.0010)	(0.0017)	(0.0025)	(0.0017)
5 years after death	0.0021**	0.0037**	0.0016	-0.0008	0.0013	-0.0019
	(0.0010)	(0.0015)	(0.0010)	(0.0018)	(0.0029)	(0.0018)
6 years after death	0.0025**	0.0044**	0.0018*	0.0012	0.0036	0.0000
	(0.0011)	(0.0017)	(0.0011)	(0.0021)	(0.0032)	(0.0021)
7 years after death	0.0023*	0.0045**	0.0021*	0.0006	0.0032	-0.0008
	(0.0012)	(0.0019)	(0.0012)	(0.0022)	(0.0037)	(0.0022)
8 years after death	0.0017	0.0041**	0.0016	0.0030	0.0058	0.0015
	(0.0014)	(0.0020)	(0.0013)	(0.0024)	(0.0041)	(0.0025)
9 years after death	0.0025*	0.0054**	0.0022	0.0012	0.0043	-0.0005
	(0.0015)	(0.0023)	(0.0015)	(0.0027)	(0.0045)	(0.0028)
10 years after death	0.0035**	0.0066***	0.0027	0.0004	0.0035	-0.0015
	(0.0017)	(0.0023)	(0.0017)	(0.0030)	(0.0048)	(0.0030)
Observations	343,600	343,600	330,905	125,187	125,187	125,187
No of individuals	18,272	18,272	17,485	6,676	6,676	6,676
R-squared	0.0038	0.1480	0.0066	0.0044	0.1637	0.0113
Age fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Individual fixed effects	NO	YES	NO	NO	YES	NO
Additional controls	NO	NO	YES	NO	NO	YES
Mean $Y_{t=-1}$	0.0045	0.0045	0.0042	0.0062	0.0062	0.0062

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20.

Table A2b: Alternate Event Study Models, By Parental Death, Females

	Father (1)	Father (2)	Father (3)	Mother (4)	Mother (5)	Mother (6)
8 years before death	0.0004	-0.0025	0.0008	-0.0003	-0.0014	0.0000
	(0.0006)	(0.0018)	(0.0006)	(0.0012)	(0.0013)	(0.0012)
7 years before death	0.0006	-0.0018	0.0010	0.0010	-0.0001	0.0013
	(0.0006)	(0.0016)	(0.0006)	(0.0012)	(0.0014)	(0.0012)
6 years before death	0.0007	-0.0013	0.0010	-0.0002	-0.0011	0.0000
	(0.0006)	(0.0013)	(0.0006)	(0.0011)	(0.0012)	(0.0011)
5 years before death	0.0003	-0.0013	0.0005	0.0003	-0.0004	0.0005
	(0.0006)	(0.0011)	(0.0006)	(0.0011)	(0.0012)	(0.0011)
4 years before death	0.0003	-0.0009	0.0005	0.0005	-0.0000	0.0007
	(0.0006)	(0.0010)	(0.0006)	(0.0011)	(0.0011)	(0.0011)
3 years before death	-0.0003	-0.0011	-0.0002	0.0013	0.0009	0.0014
	(0.0006)	(0.0008)	(0.0006)	(0.0011)	(0.0011)	(0.0011)
2 years before death	0.0005	0.0001	0.0007	0.0013	0.0011	0.0013
	(0.0006)	(0.0007)	(0.0006)	(0.0010)	(0.0010)	(0.0010)
Year of death	0.0004	0.0008	0.0003	0.0039***	0.0040***	0.0038***
	(0.0006)	(0.0007)	(0.0006)	(0.0011)	(0.0012)	(0.0011)
1 year after death	0.0004	0.0012	0.0005	0.0033***	0.0036***	0.0032**
	(0.0007)	(0.0009)	(0.0007)	(0.0013)	(0.0013)	(0.0013)
2 years after death	0.0014*	0.0026**	0.0012	0.0028**	0.0033**	0.0027**
	(0.0008)	(0.0010)	(0.0008)	(0.0014)	(0.0014)	(0.0014)
3 years after death	0.0012	0.0028**	0.0011	0.0018	0.0025*	0.0016
	(0.0008)	(0.0012)	(0.0008)	(0.0014)	(0.0014)	(0.0014)
4 years after death	0.0012	0.0031**	0.0007	0.0006	0.0015	0.0004
	(0.0009)	(0.0014)	(0.0009)	(0.0015)	(0.0015)	(0.0015)
5 years after death	0.0007	0.0030*	0.0006	0.0008	0.0020	0.0006
	(0.0010)	(0.0016)	(0.0010)	(0.0016)	(0.0015)	(0.0016)
6 years after death	0.0006	0.0034*	0.0006	0.0009	0.0022	0.0006
	(0.0010)	(0.0019)	(0.0010)	(0.0018)	(0.0016)	(0.0018)
7 years after death	0.0005	0.0036*	0.0001	0.0004	0.0019	0.0001
	(0.0011)	(0.0021)	(0.0011)	(0.0019)	(0.0018)	(0.0019)
8 years after death	0.0002	0.0036	-0.0001	0.0009	0.0025	0.0006
	(0.0012)	(0.0023)	(0.0012)	(0.0021)	(0.0019)	(0.0021)
9 years after death	0.0008	0.0045*	0.0006	0.0008	0.0025	0.0004
	(0.0012)	(0.0026)	(0.0013)	(0.0023)	(0.0020)	(0.0023)
10 years after death	0.0002	0.0042	0.0001	-0.0002	0.0018	-0.0006
	(0.0014)	(0.0027)	(0.0014)	(0.0025)	(0.0018)	(0.0025)
Observations	334,878	334,878	324,440	118,081	118,081	118,081
Number of individuals	17,798	17,798	17,157	6,299	6,299	6,299
R-squared	0.0028	0.1599	0.0053	0.0037	0.1710	0.0082
Age fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Individual fixed effects	NO	YES	NO	NO	YES	NO
Additional controls	NO	NO	YES	NO	NO	YES
Mean $Y_{t=-1}$	0.0039	0.0039	0.0039	0.0037	0.0037	0.0037

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20.

Table A3a: Event Study Models by Cause of Hospitalization, Paternal Death, Males

	All	Depression	Anxiety	Substance	Self-harm
	(1)	(2)	(3)	(4)	(5)
8 years before death	0.0003	0.0001	-0.0001	-0.0000	0.0001
	(0.0008)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
7 years before death	0.0008	0.0000	-0.0000	0.0000	0.0001
	(0.0008)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
6 years before death	0.0008	-0.0000	0.0001	0.0000	0.0000
	(0.0007)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
5 years before death	0.0009	0.0001	-0.0000	-0.0001	0.0001
	(0.0007)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
4 years before death	0.0006	0.0003	0.0000	-0.0001	0.0002
	(0.0007)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
3 years before death	0.0003	0.0000	0.0002	0.0001	0.0001
	(0.0006)	(0.0002)	(0.0002)	(0.0003)	(0.0001)
2 years before death	0.0006	-0.0000	0.0003	-0.0002	0.0001
	(0.0006)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Year of death	0.0044***	0.0008**	0.0005**	0.0005	0.0002
	(0.0008)	(0.0003)	(0.0002)	(0.0003)	(0.0002)
1 year after death	0.0039***	0.0010***	0.0002	0.0008*	0.0002
	(0.0009)	(0.0003)	(0.0002)	(0.0004)	(0.0002)
2 years after death	0.0029***	0.0009**	0.0001	0.0004	0.0005**
	(0.0009)	(0.0004)	(0.0002)	(0.0004)	(0.0002)
3 years after death	0.0029***	0.0005	0.0004	-0.0000	0.0004
	(0.0010)	(0.0003)	(0.0003)	(0.0004)	(0.0003)
4 years after death	0.0014	-0.0001	0.0003	-0.0004	0.0002
	(0.0010)	(0.0003)	(0.0002)	(0.0005)	(0.0002)
5 years after death	0.0021**	0.0003	0.0004	0.0002	0.0006**
	(0.0010)	(0.0004)	(0.0003)	(0.0005)	(0.0003)
6 years after death	0.0025**	0.0001	0.0006**	0.0001	0.0004
	(0.0011)	(0.0003)	(0.0003)	(0.0006)	(0.0003)
7 years after death	0.0023*	0.0007*	0.0005*	-0.0000	0.0004
	(0.0012)	(0.0004)	(0.0003)	(0.0006)	(0.0003)
8 years after death	0.0017	-0.0002	0.0008**	0.0002	0.0006*
	(0.0014)	(0.0004)	(0.0003)	(0.0007)	(0.0004)
9 years after death	0.0025*	0.0002	0.0007**	0.0001	0.0007*
	(0.0015)	(0.0005)	(0.0003)	(0.0008)	(0.0004)
10 years after death	0.0035**	0.0003	0.0007*	0.0005	0.0006
	(0.0017)	(0.0005)	(0.0004)	(0.0009)	(0.0004)
Observations	343,600	343,600	343,600	343,600	343,600
No of individuals	18,272	18,272	18,272	18,272	18,272
R-squared	0.0038	0.0009	0.0010	0.0023	0.0008
Mean $Y_{t=-1}$	0.0045	0.00049	0.00022	0.00088	0.00022

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20. All models contain year and age fixed effects.

Table A3b: Event Study Models by Cause of Hospitalization, Maternal Death, Males

	All	Depression	Anxiety	Substance	Self-harm
	(1)	(2)	(3)	(4)	(5)
8 years before death	-0.0006	0.0004	0.0003*	0.0003	-0.0000
	(0.0015)	(0.0005)	(0.0002)	(0.0004)	(0.0002)
7 years before death	0.0017	0.0003	0.0004*	0.0001	-0.0001
	(0.0015)	(0.0005)	(0.0002)	(0.0004)	(0.0002)
6 years before death	-0.0006	-0.0001	0.0003*	0.0001	-0.0001
	(0.0014)	(0.0004)	(0.0002)	(0.0004)	(0.0002)
5 years before death	0.0002	-0.0003	0.0004*	0.0001	-0.0002
	(0.0013)	(0.0004)	(0.0002)	(0.0004)	(0.0002)
4 years before death	-0.0003	-0.0004	0.0003*	0.0001	0.0001
	(0.0012)	(0.0004)	(0.0002)	(0.0004)	(0.0003)
3 years before death	0.0018	-0.0004	0.0002	0.0004	-0.0001
	(0.0013)	(0.0004)	(0.0002)	(0.0004)	(0.0003)
2 years before death	0.0006	-0.0003	0.0005*	0.0004	0.0003
	(0.0011)	(0.0004)	(0.0003)	(0.0005)	(0.0003)
Year of death	0.0028*	0.0000	0.0008*	0.0003	0.0002
	(0.0015)	(0.0006)	(0.0004)	(0.0006)	(0.0004)
1 year after death	0.0020	0.0006	0.0001	0.0005	0.0002
	(0.0015)	(0.0006)	(0.0004)	(0.0006)	(0.0004)
2 years after death	0.0001	-0.0008	-0.0003	0.0003	0.0004
	(0.0015)	(0.0005)	(0.0003)	(0.0007)	(0.0004)
3 years after death	0.0002	-0.0004	0.0001	0.0002	0.0003
	(0.0016)	(0.0006)	(0.0004)	(0.0007)	(0.0004)
4 years after death	0.0003	-0.0001	-0.0000	0.0005	-0.0002
	(0.0017)	(0.0007)	(0.0004)	(0.0008)	(0.0004)
5 years after death	-0.0008	0.0003	-0.0001	0.0005	0.0003
	(0.0018)	(0.0007)	(0.0005)	(0.0008)	(0.0005)
6 years after death	0.0012	-0.0003	0.0010	0.0002	0.0001
	(0.0021)	(0.0007)	(0.0006)	(0.0009)	(0.0006)
7 years after death	0.0006	0.0005	0.0003	0.0007	0.0005
	(0.0022)	(0.0008)	(0.0006)	(0.0011)	(0.0006)
8 years after death	0.0030	-0.0002	0.0006	0.0027**	0.0000
	(0.0024)	(0.0008)	(0.0006)	(0.0012)	(0.0006)
9 years after death	0.0012	-0.0005	-0.0003	0.0009	0.0001
	(0.0027)	(0.0008)	(0.0005)	(0.0013)	(0.0007)
10 years after death	0.0004	0.0001	-0.0001	0.0005	-0.0001
	(0.0030)	(0.0010)	(0.0005)	(0.0014)	(0.0007)
Observations	125,187	125,187	125,187	125,187	125,187
No of individuals	6,676	6,676	6,676	6,676	6,676
R-squared	0.0044	0.0012	0.0017	0.0031	0.0014
Mean $Y_{t=-1}$	0.0062	0.00090	0.00015	0.00075	0.00030

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20. All models contain year and age fixed effects.

Table A3c: Event Study Models by Cause of Hospitalization, Paternal Death, Females

	All	Depression	Anxiety	Substance	Self-harm
	(1)	(2)	(3)	(4)	(5)
8 years before death	0.0004	0.0002	-0.0000	-0.0000	0.0001
	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
7 years before death	0.0006	0.0001	-0.0000	-0.0000	0.0001
	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0002)
6 years before death	0.0007	0.0001	0.0000	0.0000	0.0000
	(0.0006)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
5 years before death	0.0003	0.0003	-0.0001	0.0000	0.0002
	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0003)
4 years before death	0.0003	0.0001	-0.0001	0.0001	0.0003
	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0003)
3 years before death	-0.0003	-0.0001	0.0000	-0.0001	-0.0000
	(0.0006)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
2 years before death	0.0005	0.0000	-0.0001	0.0000	-0.0000
	(0.0006)	(0.0003)	(0.0001)	(0.0002)	(0.0003)
Year of death	0.0004	-0.0004	0.0002	-0.0002	0.0001
	(0.0006)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
1 year after death	0.0004	0.0004	0.0001	0.0003	-0.0001
	(0.0007)	(0.0004)	(0.0002)	(0.0003)	(0.0003)
2 years after death	0.0014*	0.0007	0.0001	0.0003	0.0000
	(0.0008)	(0.0005)	(0.0002)	(0.0003)	(0.0004)
3 years after death	0.0012	0.0006	-0.0000	-0.0000	-0.0001
	(0.0008)	(0.0005)	(0.0002)	(0.0003)	(0.0004)
4 years after death	0.0012	0.0004	0.0005*	0.0008**	-0.0005
	(0.0009)	(0.0005)	(0.0003)	(0.0004)	(0.0004)
5 years after death	0.0007	0.0000	0.0001	0.0002	-0.0007*
	(0.0010)	(0.0005)	(0.0003)	(0.0004)	(0.0004)
6 years after death	0.0006	-0.0000	0.0002	-0.0001	-0.0006
	(0.0010)	(0.0005)	(0.0003)	(0.0004)	(0.0004)
7 years after death	0.0005	0.0002	-0.0000	0.0003	-0.0009**
	(0.0011)	(0.0006)	(0.0003)	(0.0005)	(0.0004)
8 years after death	0.0002	0.0002	0.0002	0.0000	-0.0003
	(0.0012)	(0.0006)	(0.0003)	(0.0005)	(0.0005)
9 years after death	0.0008	0.0008	0.0003	0.0002	-0.0007
	(0.0012)	(0.0006)	(0.0003)	(0.0005)	(0.0005)
10 years after death	0.0002	0.0002	-0.0001	0.0004	-0.0006
	(0.0014)	(0.0007)	(0.0003)	(0.0006)	(0.0005)
Observations	334,878	334,878	334,878	334,878	334,878
No of individuals	17,798	17,798	17,798	17,798	17,798
R-squared	0.0028	0.0020	0.0006	0.0012	0.0010
Mean $Y_{t=-1}$	0.00389	0.00107	0.00028	0.00051	0.00085

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20. All models contain year and age fixed effects.

Table A3d: Event Study Models by Cause of Hospitalization, Maternal Death, Females

	All	Depression	Anxiety	Substance	Self-harm
	(1)	(2)	(3)	(4)	(5)
8 years before death	-0.0003	0.0006	-0.0001	0.0001	0.0003
	(0.0012)	(0.0004)	(0.0002)	(0.0002)	(0.0002)
7 years before death	0.0010	0.0006*	-0.0001	0.0001	0.0003*
	(0.0012)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
6 years before death	-0.0002	0.0007*	-0.0001	0.0001	0.0002
	(0.0011)	(0.0004)	(0.0002)	(0.0002)	(0.0002)
5 years before death	0.0003	0.0005	-0.0001	0.0002	0.0004
	(0.0011)	(0.0004)	(0.0002)	(0.0003)	(0.0003)
4 years before death	0.0005	0.0005	-0.0001	0.0000	0.0002
	(0.0011)	(0.0004)	(0.0002)	(0.0003)	(0.0002)
3 years before death	0.0013	0.0007	-0.0001	0.0000	-0.0001
	(0.0011)	(0.0005)	(0.0002)	(0.0003)	(0.0002)
2 years before death	0.0013	0.0002	0.0001	0.0004	0.0000
	(0.0010)	(0.0004)	(0.0002)	(0.0004)	(0.0002)
Year of death	0.0039***	0.0011*	0.0004	0.0003	0.0013**
	(0.0011)	(0.0006)	(0.0004)	(0.0004)	(0.0005)
1 year after death	0.0033***	0.0021***	0.0001	0.0006	0.0018***
	(0.0013)	(0.0008)	(0.0003)	(0.0004)	(0.0006)
2 years after death	0.0028**	0.0016**	0.0001	0.0004	0.0006
	(0.0014)	(0.0008)	(0.0004)	(0.0004)	(0.0005)
3 years after death	0.0018	0.0013	0.0003	0.0004	0.0007
	(0.0014)	(0.0009)	(0.0004)	(0.0004)	(0.0005)
4 years after death	0.0006	-0.0003	0.0007	-0.0002	0.0009
	(0.0015)	(0.0008)	(0.0005)	(0.0004)	(0.0006)
5 years after death	0.0008	-0.0010	0.0009*	-0.0001	0.0004
	(0.0016)	(0.0008)	(0.0005)	(0.0006)	(0.0006)
6 years after death	0.0009	-0.0003	-0.0002	0.0010	0.0003
	(0.0018)	(0.0009)	(0.0004)	(0.0008)	(0.0006)
7 years after death	0.0004	-0.0001	0.0000	0.0005	-0.0002
	(0.0019)	(0.0010)	(0.0005)	(0.0008)	(0.0006)
8 years after death	0.0009	-0.0004	0.0010	0.0002	0.0002
	(0.0021)	(0.0012)	(0.0006)	(0.0008)	(0.0007)
9 years after death	0.0008	0.0008	-0.0005	0.0005	0.0001
	(0.0023)	(0.0013)	(0.0004)	(0.0010)	(0.0007)
10 years after death	-0.0002	-0.0003	-0.0001	0.0000	0.0011
	(0.0025)	(0.0013)	(0.0005)	(0.0011)	(0.0009)
Observations	118,081	118,081	118,081	118,081	118,081
No of individuals	6,299	6,299	6,299	6,299	6,299
R-squared	0.0037	0.0023	0.0013	0.0015	0.0016
Mean $Y_{t=-1}$	0.00367	0.00080	0.00016	0.00032	0.00016

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. Sample is limited to individuals with a parental death ages 10–20. All models contain year and age fixed effects.

Table A4a: Difference-in-Differences Event Study Models, Males

	Father dies		Mother dies	
	Treatment	Control	Treatment	Control
VARIABLES	(1)	(2)	(3)	(4)
8 years before death	0.0003	0.0000	-0.0006	-0.0004
	(0.0008)	(0.0002)	(0.0015)	(0.0002)
7 years before death	0.0008	-0.0001	0.0017	-0.0004**
	(0.0008)	(0.0002)	(0.0015)	(0.0002)
6 years before death	0.0008	-0.0001	-0.0006	-0.0002
	(0.0007)	(0.0002)	(0.0014)	(0.0002)
5 years before death	0.0009	0.0001	0.0002	-0.0003
	(0.0007)	(0.0002)	(0.0013)	(0.0002)
4 years before death	0.0006	0.0001	-0.0003	-0.0002
	(0.0007)	(0.0002)	(0.0012)	(0.0002)
3 years before death	0.0003	0.0001	0.0018	-0.0001
	(0.0006)	(0.0002)	(0.0013)	(0.0002)
2 years before death	0.0006	0.0003*	0.0006	-0.0003*
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
Year of death	0.0044***	0.0001	0.0028*	-0.0001
	(0.0008)	(0.0002)	(0.0015)	(0.0002)
1 year after death	0.0039***	0.0002	0.0020	-0.0002
	(0.0009)	(0.0002)	(0.0015)	(0.0002)
2 years after death	0.0029***	0.0004*	0.0001	-0.0001
	(0.0009)	(0.0002)	(0.0015)	(0.0002)
3 years after death	0.0029***	0.0002	0.0002	0.0001
	(0.0010)	(0.0002)	(0.0016)	(0.0002)
4 years after death	0.0014	0.0004*	0.0003	0.0000
	(0.0010)	(0.0003)	(0.0017)	(0.0003)
5 years after death	0.0021**	0.0003	-0.0008	-0.0000
	(0.0010)	(0.0003)	(0.0018)	(0.0003)
6 years after death	0.0025**	0.0003	0.0012	0.0001
	(0.0011)	(0.0003)	(0.0021)	(0.0003)
7 years after death	0.0023*	0.0008**	0.0006	-0.0005
	(0.0012)	(0.0003)	(0.0022)	(0.0003)
8 years after death	0.0017	0.0003	0.0030	0.0003
	(0.0014)	(0.0003)	(0.0024)	(0.0004)
9 years after death	0.0025*	0.0004	0.0012	-0.0002
	(0.0015)	(0.0004)	(0.0027)	(0.0004)
10 years after death	0.0035**	0.0005	0.0004	-0.0004
	(0.0017)	(0.0004)	(0.0030)	(0.0004)
Observations	343,600	2,614,608	125,187	2,769,002
Number of individuals	18,272	138,094	6,676	146,318
R-squared	0.0038	0.0022	0.0044	0.0022
Mean $Y_{t=-1}$	0.0045	0.0027	0.0062	0.0033

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. All models contain year and age fixed effects.

Table A4b: Difference-in-Differences Event Study Models, Females

	Father dies		Mother dies	
	Treatment	Control	Treatment	Control
VARIABLES	(1)	(2)	(3)	(4)
8 years before death	0.0004	0.0002	-0.0003	0.0000
	(0.0006)	(0.0002)	(0.0012)	(0.0002)
7 years before death	0.0006	0.0002	0.0010	-0.0001
	(0.0006)	(0.0002)	(0.0012)	(0.0002)
6 years before death	0.0007	0.0001	-0.0002	-0.0000
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
5 years before death	0.0003	0.0002	0.0003	-0.0001
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
4 years before death	0.0003	0.0001	0.0005	-0.0002
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
3 years before death	-0.0003	0.0001	0.0013	-0.0003
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
2 years before death	0.0005	0.0002	0.0013	-0.0002
	(0.0006)	(0.0002)	(0.0010)	(0.0002)
Year of death	0.0004	0.0003	0.0039***	-0.0002
	(0.0006)	(0.0002)	(0.0011)	(0.0002)
1 year after death	0.0004	-0.0000	0.0033***	0.0000
	(0.0007)	(0.0002)	(0.0013)	(0.0002)
2 years after death	0.0014*	0.0004*	0.0028**	-0.0002
	(0.0008)	(0.0002)	(0.0014)	(0.0002)
3 years after death	0.0012	0.0002	0.0018	0.0001
	(0.0008)	(0.0002)	(0.0014)	(0.0002)
4 years after death	0.0012	0.0004*	0.0006	0.0003
	(0.0009)	(0.0002)	(0.0015)	(0.0002)
5 years after death	0.0007	0.0009***	0.0008	0.0002
	(0.0010)	(0.0003)	(0.0016)	(0.0003)
6 years after death	0.0006	0.0006**	0.0009	0.0003
	(0.0010)	(0.0003)	(0.0018)	(0.0003)
7 years after death	0.0005	0.0004	0.0004	0.0003
	(0.0011)	(0.0003)	(0.0019)	(0.0003)
8 years after death	0.0002	0.0008**	0.0009	0.0004
	(0.0012)	(0.0003)	(0.0021)	(0.0003)
9 years after death	0.0008	0.0003	0.0008	0.0002
	(0.0012)	(0.0004)	(0.0023)	(0.0004)
10 years after death	0.0002	0.0002	-0.0002	0.0003
	(0.0014)	(0.0004)	(0.0025)	(0.0004)
Observations	334,878	2,475,950	118,081	2,636,944
Number of individuals	17,798	130,887	6,299	139,468
R-squared	0.0028	0.0015	0.0037	0.0014
Mean $Y_{t=-1}$	0.0039	0.0021	0.0037	0.0026

Notes: Standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column is from a separate linear probability model where the dependent variable is a dummy variable equal to one for being hospitalized for a mental health condition in that year. All models contain year and age fixed effects.

Figure A1: Hospitalization Rate Before and After the Parental Death in the Treatment Groups (Raw Data)

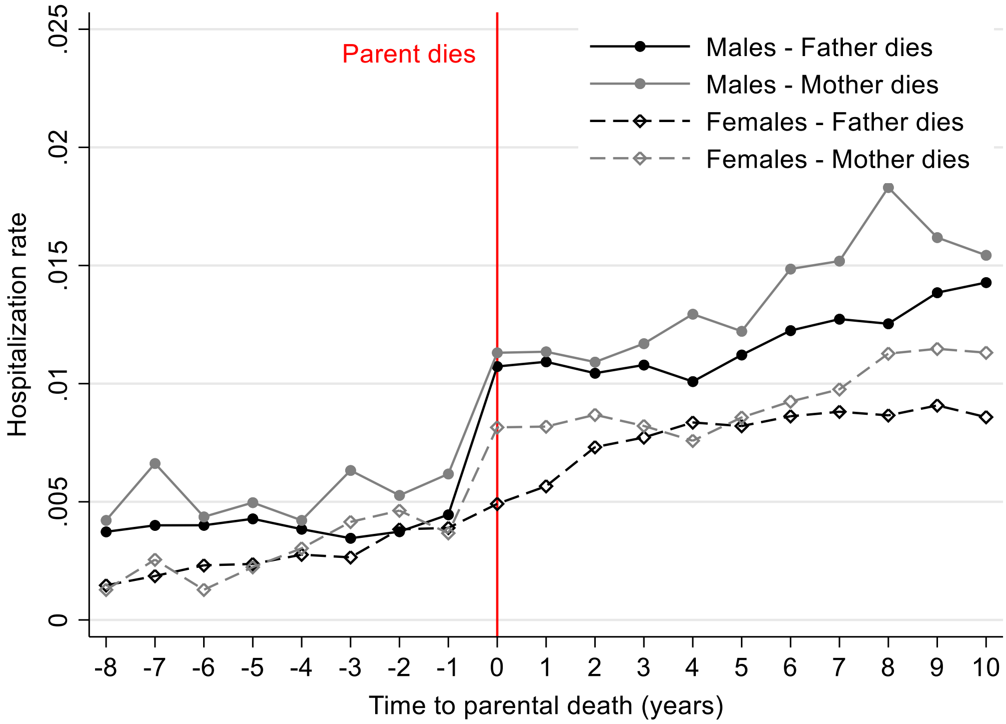
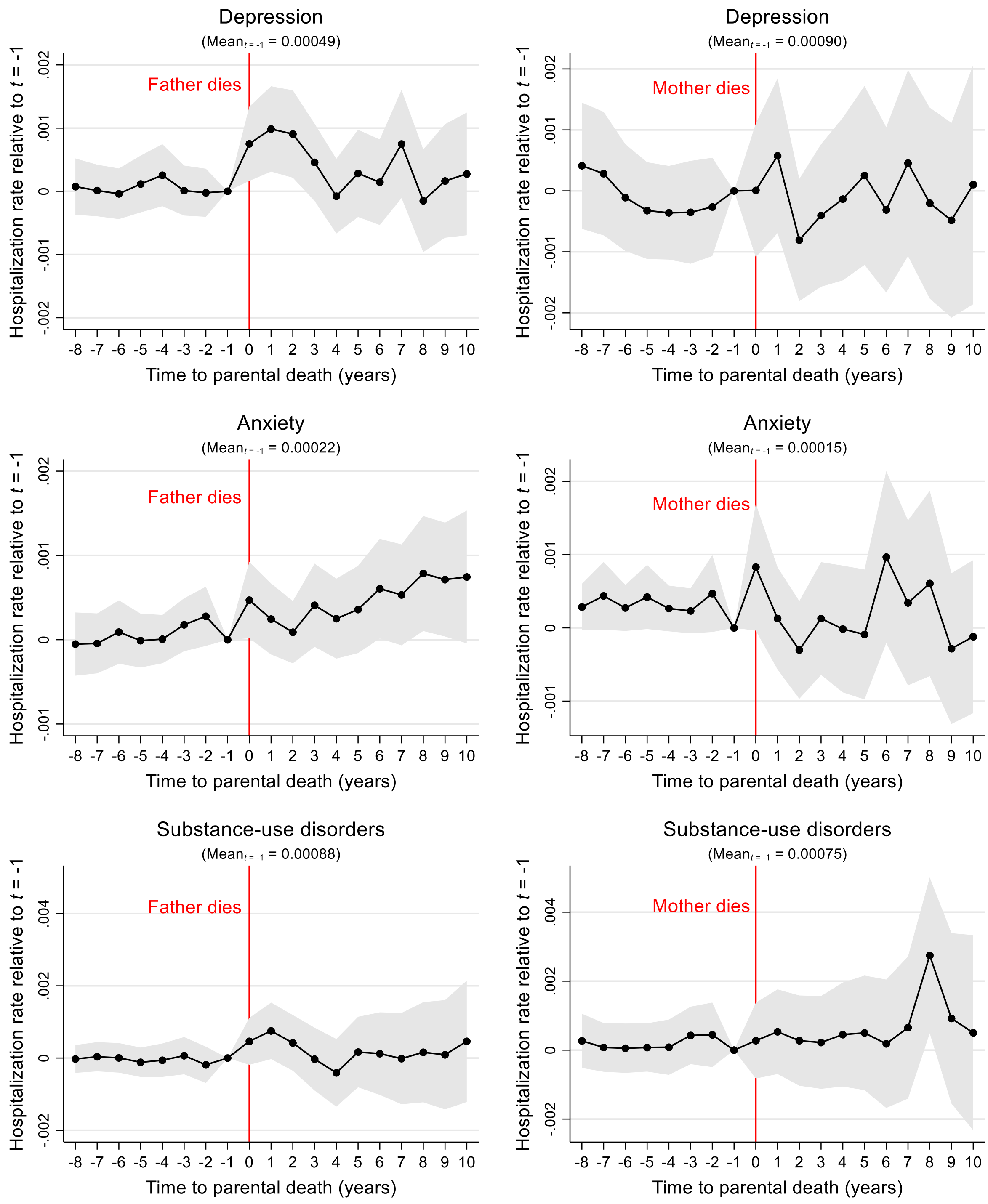
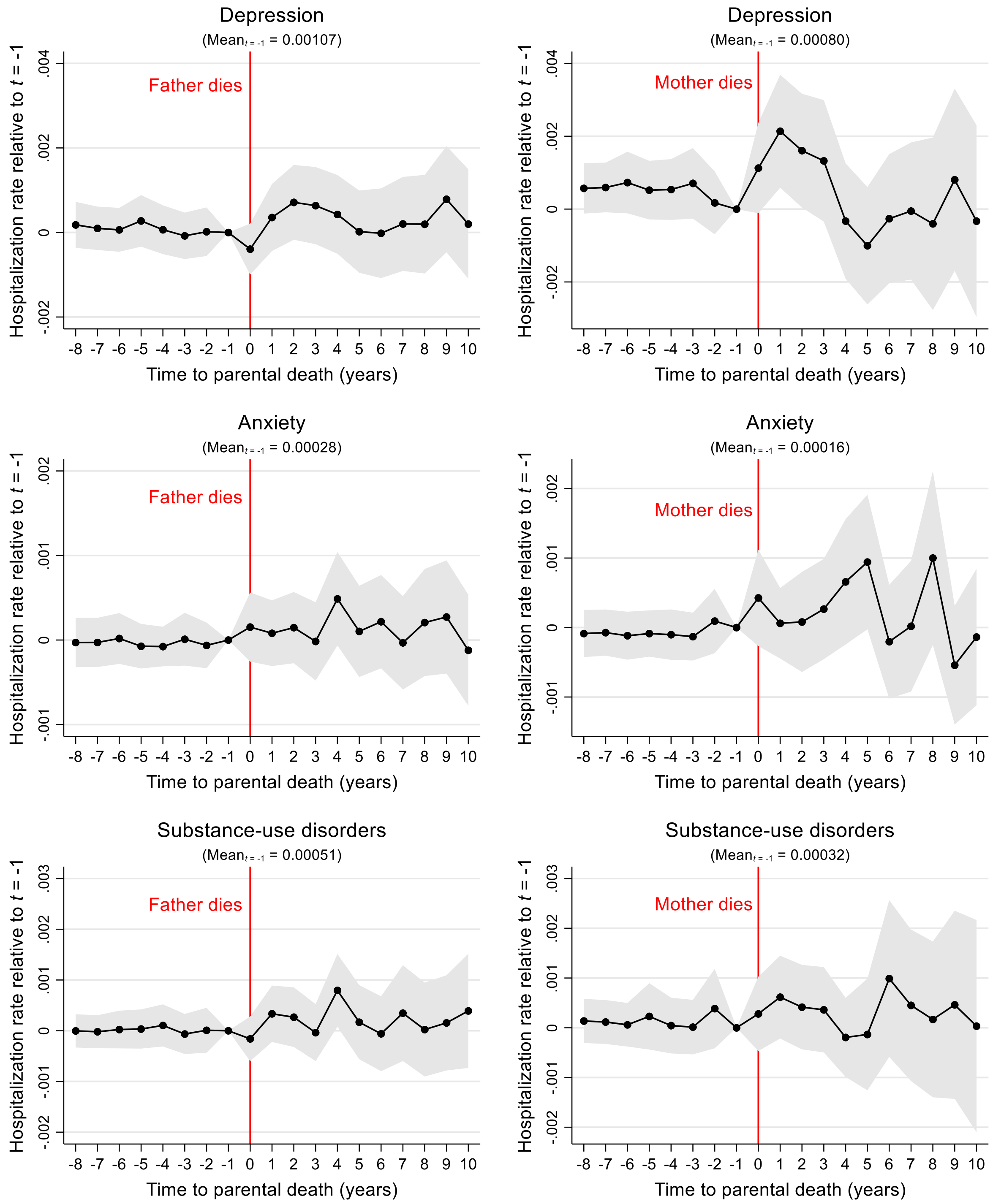


Figure A2b: Event Study Results by Cause of Hospitalization, Males



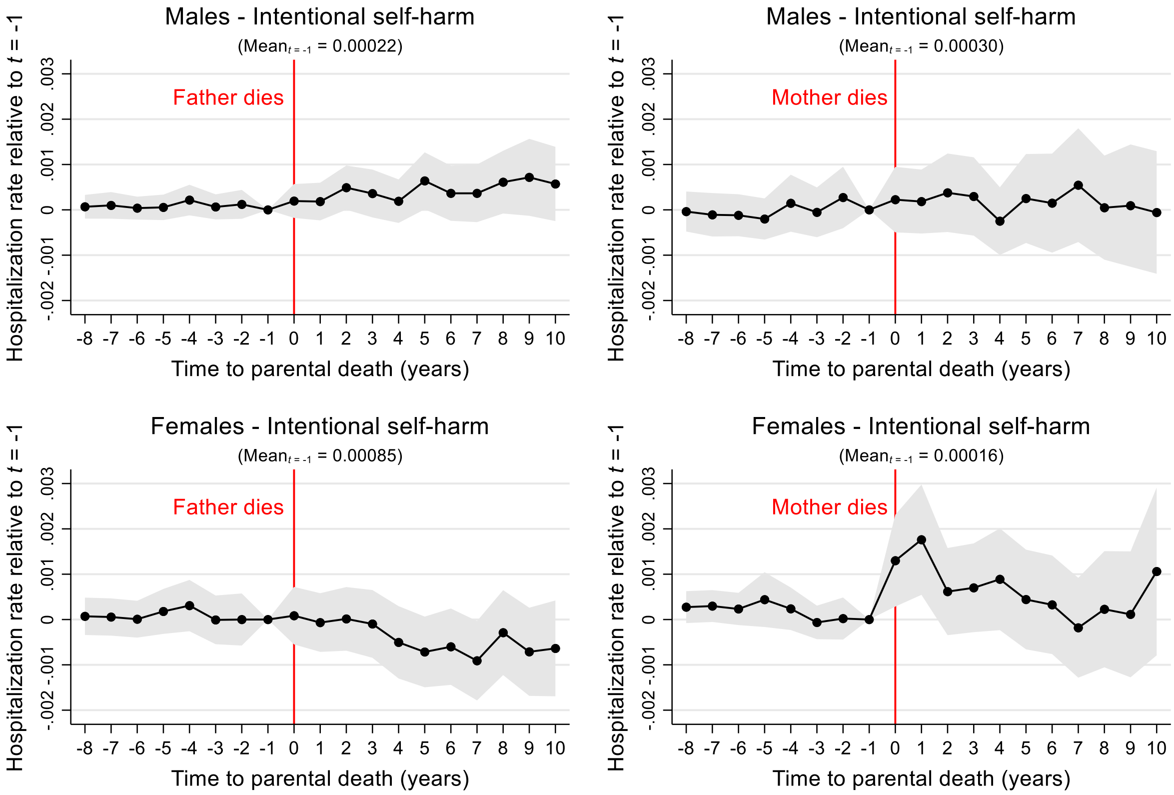
Notes: The figures plot the coefficient estimates from event study regressions together with 95% confidence intervals (standard errors clustered at the individual level). See Tables A3a and A3b for tabulation of estimation results and further details.

Figure A2b: Event Study Results by Cause of Hospitalization, Females



Notes: The figures plot the coefficient estimates from event study regressions together with 95% confidence intervals (standard errors clustered at the individual level). See Tables A3c and A3d for tabulation of estimation results and further details.

Figure A3: Event Study Results, Intentional Self-Harm, Males and Females



Notes: The figures plot the coefficient estimates from event study regressions together with 95% confidence intervals (standard errors clustered at the individual level). See Tables A3a–A3d for tabulation of estimation results and further details.

APPENDIX B. PRE-TREND AND IMPUTATION ESTIMATION RESULTS

Pre-Trend Testing for Our Baseline Model

To investigate the validity of the parallel trend assumption of our baseline event study approach, we follow Borusyak et al. (2021) and estimate our model using the set of observations prior to treatment:

$$Y_{ist} = \sum_{j=-7}^{-1} \gamma_j \cdot I[t = j] + \sum_k \beta_k \cdot I[age_{is} = k] + \sum_y \tau_y \cdot I[s = y] + \varepsilon_{ist},$$

where $I[t = j]$ are indicator variables of being treated 1 to 7 years later, the comparison group consisting of those experiencing the parental death eight years later. After estimation of the model, the joint statistical significance of the γ_j's is tested using F-test. Further, the individual pre-trend coefficients can reveal possible anticipation effects to parental death that would violate the identification assumption of our model. As explained by Borusyak et al. (2021) the key advantage of this test approach is that it separates the validation of the parallel trend assumption from the estimation, given the event study design. The results reported in Table B1 do not reveal evidence of significant pre-trends based on individual t-tests or a joint significance F-test. Table B2 reports the corresponding results for the control group used in our difference-in-differences design. Again, we do not find evidence of significant pre-trends.

Table B1: Pre-Trend Testing for the Baseline Event Study Approach – Treatment Group

	Males, Father (1)	Males, Mother (2)	Females, Father (3)	Females, Mother (4)
7 years before death	0.0004	0.0022**	0.0003	0.0012
	(0.0006)	(0.0010)	(0.0004)	(0.0007)
6 years before death	0.0004	0.0000	0.0003	0.0001
	(0.0006)	(0.0011)	(0.0005)	(0.0006)
5 years before death	0.0006	0.0009	-0.0002	0.0007
	(0.0007)	(0.0012)	(0.0005)	(0.0008)
4 years before death	0.0003	0.0003	-0.0002	0.0010
	(0.0007)	(0.0012)	(0.0005)	(0.0009)
3 years before death	0.0000	0.0026*	-0.0007	0.0016
	(0.0007)	(0.0015)	(0.0005)	(0.0011)
2 years before death	-0.0000	0.0016	0.0002	0.0013
	(0.0007)	(0.0014)	(0.0006)	(0.0012)
1 years before death	-0.0003	0.0022	-0.0001	0.0005
	(0.0008)	(0.0015)	(0.0007)	(0.0012)
Observations	145,711	53,130	141,907	50,140
Number of individuals	18,259	6,669	17,788	6,289
R-squared	0.0013	0.0014	0.0021	0.0021
Age fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Individual fixed effects	NO	NO	NO	NO

F-test value	0.319	1.547	0.740	0.691
F-test p-value	0.946	0.147	0.638	0.680

Notes: The outcome is the annual hospitalization rate due to mental health disorders. Standard errors clustered at the individual level are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Comparison group is the 8th year before parental death. Pre-trend coefficients that have been estimated using OLS on the pre-treatment observations only. F-test reports the joint significance of the pre-treatment coefficients (-7, …, -1).

Table B2: Pre-Trend Testing for the Event Study Approach – Control Group

	Males, Father (1)	Males, Mother (2)	Females, Father (3)	Females, Mother (4)
7 years before death	-0.0001	-0.0001	-0.0001	-0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
6 years before death	-0.0001	0.0002	-0.0002	-0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
5 years before death	0.0001	0.0001	0.0000	-0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
4 years before death	0.0001	0.0001	-0.0001	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0001)
3 years before death	0.0000	0.0002	-0.0001	-0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
2 years before death	0.0003	-0.0000	-0.0001	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
1 years before death	0.0001	0.0004*	-0.0002	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Observations	1,101,859	1,166,978	1,044,562	1,112,535
Number of individuals	138,021	146,217	130,820	139,398
R-squared	0.0006	0.0006	0.0007	0.0007
Age fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Individual fixed effects	NO	NO	NO	NO
F-test value	0.671	1.588	0.660	0.728
F-test p-value	0.697	0.134	0.707	0.649

Notes: Sample includes control individuals without a parental death by age 30. The outcome is the annual hospitalization rate due to mental health disorders. Standard errors clustered at the individual level are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Comparison group is the 8th year before parental death. Pre-trend coefficients that have been estimated using OLS on the pre-treatment observations only. F-test reports the joint significance of the pre-treatment coefficients (-7, …, -1).

Imputation Estimator Results

We examine the robustness of our baseline model to difference-in-differences design with staggered adoption of treatment (see Borusyak et al., 2021, and an application by von Bismarck-Osten et al., 2020). The design assumes that the true causal model for individual i in year *t* is:

$$Y_{it} = \alpha_i + \beta_t + \tau_{it} \cdot I[t \geq E_i] + \varepsilon_{it},$$

where α_i are the individual fixed effects, β_t are the age fixed effects, E_i is the individual's age when a parent dies (i.e., treatment), and $I[t \geq E_i]$ is the indicator for the post-treatment periods. Here, τ_{it}captures the heterogeneous treatment effects, i.e., the effects of the death of father (or mother) on mental health-related hospitalizations.

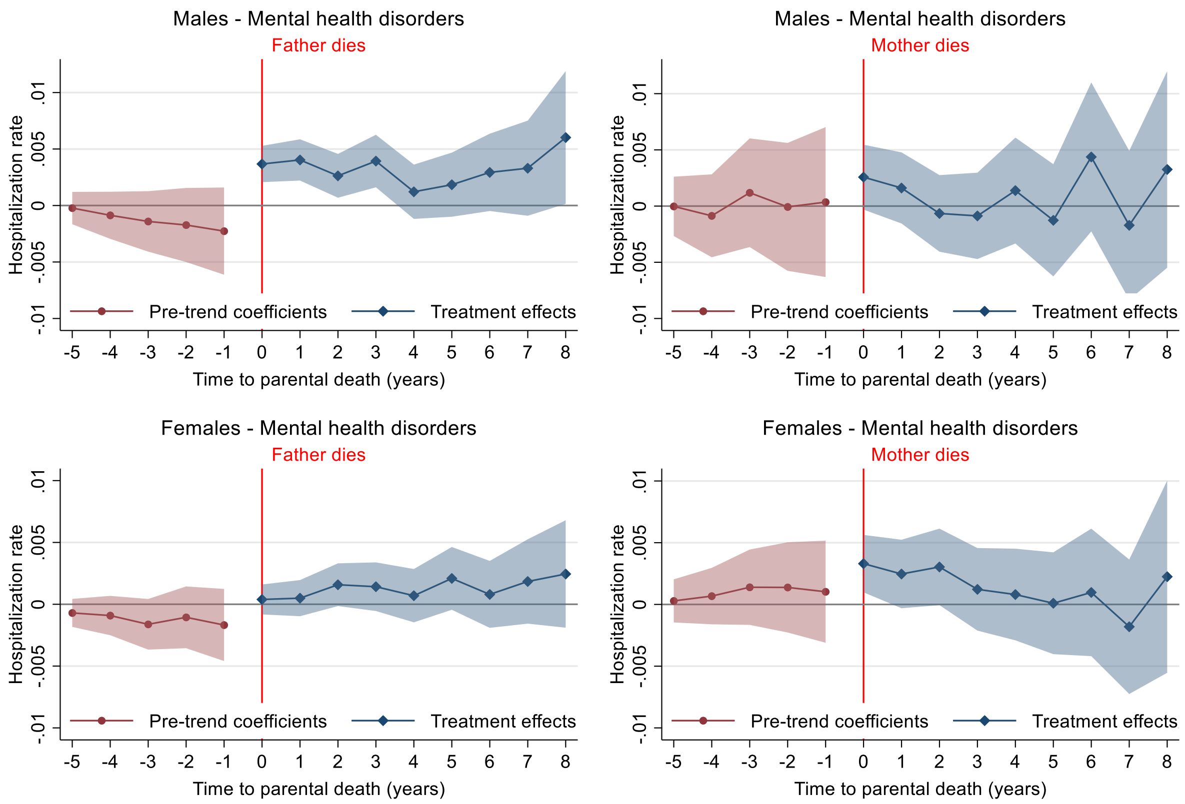
The treatment effects can be estimated using the imputation estimator proposed by Borusyak et al. (2021). The imputation estimator is based on the parallel trends assumption, but contrary to the fixed effects OLS regression with lags and leads of treatment, it produces estimates that are robust even in the presence of heterogeneous treatment effects. The imputation estimator with a particular horizon h (i.e., h years after treatment) leverages all difference-in-differences contrasts between individual i in period $E_i + h$ relative to all periods before treatment, $t < E_i$, and relative to other individuals who have not been treated by $E_i + h$.

To validate the assumptions of the imputation estimator, Figure B1 reports first the estimated pre-trend coefficients, together with their 95% confidence intervals (depicted in red). The pre-trend coefficients have been estimated using OLS with individual and age fixed effects, because the imputation estimator utilizes individual fixed effects, rather than year fixed effects. Thus, these pre-trend estimates differ slightly from those reported in Table B1.[17] However, the conclusion remains intact: the pre-trend coefficients are small and statistically insignificant, which provides support for the parallel trend assumption (and for the use of pre-treatment periods as the comparison group in the imputation estimation).

In Figure B1, treatment effects of parental death have been estimated using the imputation estimator (depicted in blue). In all cases, the estimated effects are similar to our baseline results reported in Figure 1. The pre-trend and imputation estimation results for the control group are shown in Figure B2. They are similar to those reported in Figure 2.

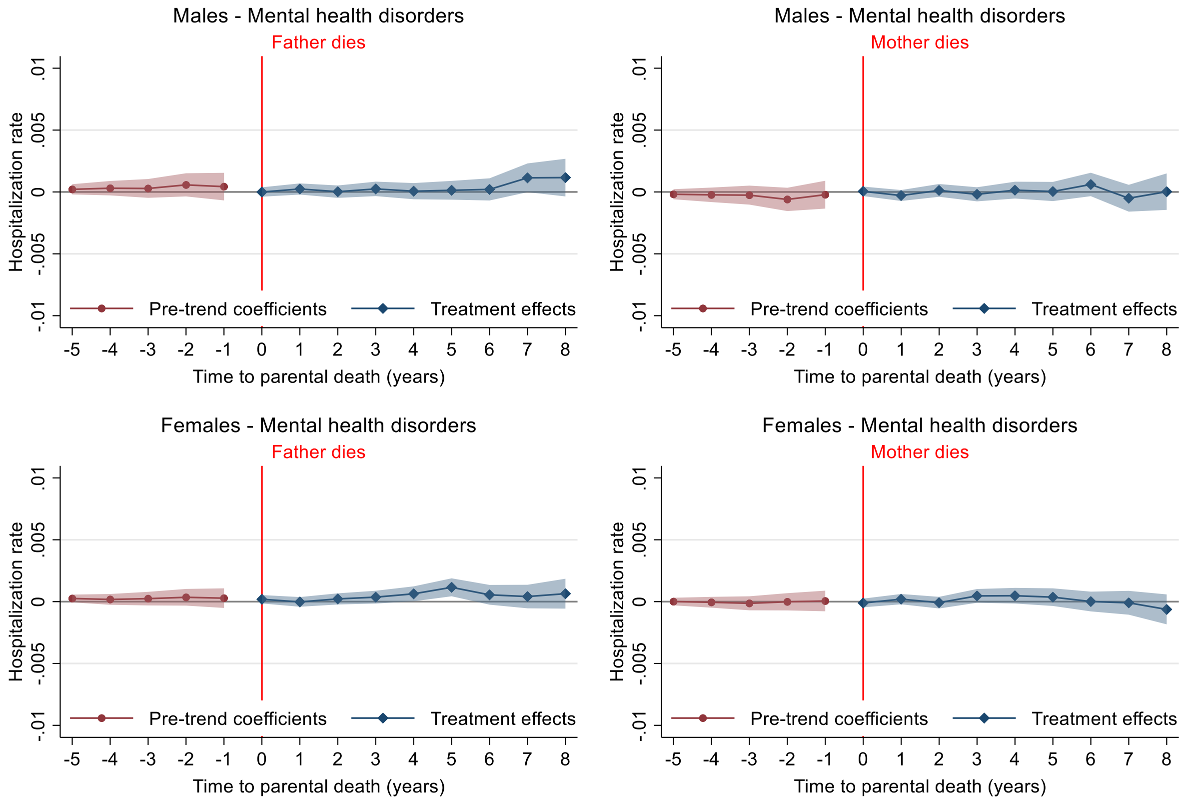
[17] When individual fixed effects are used, we need to drop two time effects from the model for identification.

Figure B1: Pre-Trend Coefficients and Treatment Estimates – Treatment Group



Notes: The outcome is the annual hospitalization rate for mental health disorders. The OLS estimates depicted in red report pre-trend coefficients estimated using pre-treatment observations only. This model includes individual and age fixed effects and assumes zero effects 6–8 years prior to parental death. The treatment effects for years 0-8 depicted in blue have been estimated using the imputation estimator of Borusyak et al. (2021) that includes individual and age fixed effects. 95% confidence intervals are reported, based on standard errors clustered at the individual level.

Figure B2: Pre-Trend Coefficients and Treatment Estimates – Control Group



Notes: Sample includes control individuals without a parental death by age 30. The outcome is the annual hospitalization rate for mental health disorders. The OLS estimates depicted in red report pre-trend coefficients estimated using pre-treatment observations only. This model includes individual and age fixed effects and assumes zero effects 6–8 years prior to parental death. The treatment effects for years 0-8 depicted in blue have been estimated using the imputation estimator of Borusyak et al. (2021) that includes individual and age fixed effects. 95% confidence intervals are reported, based on standard errors clustered at the individual level.

APPENDIX C. UNINFORMATIVE VS. INFORMATIVE PARENTAL DEATHS

To identity the explicitly exogenous causes of death, we use the approach introduced by Espinosa and Evans (2008) and adopted later in Gimenez et al. (2013). The basic idea of this approach is to classify the causes of death into two non-overlapping groups: i) deaths strongly correlated with measures of parental SES (i.e., informative causes of death, ICOD) and ii) deaths driven by likely random causes and not correlated with SES (i.e., uninformative causes of death, UCOD).

In our data, the causes of deaths are recorded using the International Classification of Diseases (ICD-8 in 1969–1986, ICD-9 in 1987–1995 and ICD-10 since 1996). To identify the deaths that are informative and uninformative, we first regroup the causes of deaths ICDs according to the Statistics Finland's classification of deaths into 54 subgroups (COD). We then use ordinary least squares estimation (OLS) to categorize each COD group according to its degree of correlation with family SES (income and education).

Following Gimenez et al. (2013), we estimate linear probability models for each of the 54 COD groups:

$$COD_{irt}^{d} = \alpha^{d} + \sum_{k=2}^{4} \beta_k^d \cdot I\left[INC(k)_{irt}^{d} = 1\right] + \sum_{k=2}^{4} \gamma_k^d \cdot I\left[EDU(k)_{irt}^{d} = 1\right] + \sum_{k=2}^{4} \eta_k^d \cdot I\left[EDUS(k)_{irt}^{d} = 1\right] + \delta_r^d + \tau_t^d + X_{irt}^{d}\theta^{d} + \varepsilon_{irt}^{d}$$

where COD_{irt}^{d} is 1 for parent i who resided in region r and died from cause of death d in year t (and 0 otherwise). For example, variable COD_{irt}^{6} equals 1 if a parent i died from a malignant neoplasm of stomach during a 25-year follow-up period after the child's birth, and 0 if the cause of death is different. $I\left[INC(k)_{irt}^{d} = 1\right]$ equals one if the family income of parent i is in the kth income quartile; $I\left[EDU(k)_{irt}^{d} = 1\right]$ and $I\left[EDUS(k)_{irt}^{d} = 1\right]$ represent four indicator variables for the education level k attained by the deceased parent i and attained by his/her spouse, respectively. δ_r^d and τ_t^d represent region and year-of-death fixed effects, respectively. X_{irt}^{d} contains four dummies of age (quartiles) at the time of death. Models are estimated separately for fathers and mothers.

For each regression, we conducted four F-tests: i) whether the coefficient estimates for the income level, ii) the education indicators for the deceased, iii) the education indicators for the spouse of the deceased, and iv) all three sets, income, own education, and spousal education indicators, respectively, are jointly zero. If we can reject any of the four null hypotheses at the five percent confidence level, then the cause of death COD^{d} is considered to be informative (ICOD); otherwise, the COD^{d} is considered to be uninformative (UCOD).

Table C1 summarizes the results of the regressions for top five ICODs and UCODs for fathers and mothers. Overall, approximately 14.7 percent of the father's deaths were classified as UCODs. The corresponding figure for the mothers is 8.9 percent. To evaluate the robustness of our baseline findings, we estimate separate effects for uninformative causes of death (UCOD) and informative causes of death (ICOD) using event study models and cross-sectional models. These results are illustrated in Figures 3 and C1.

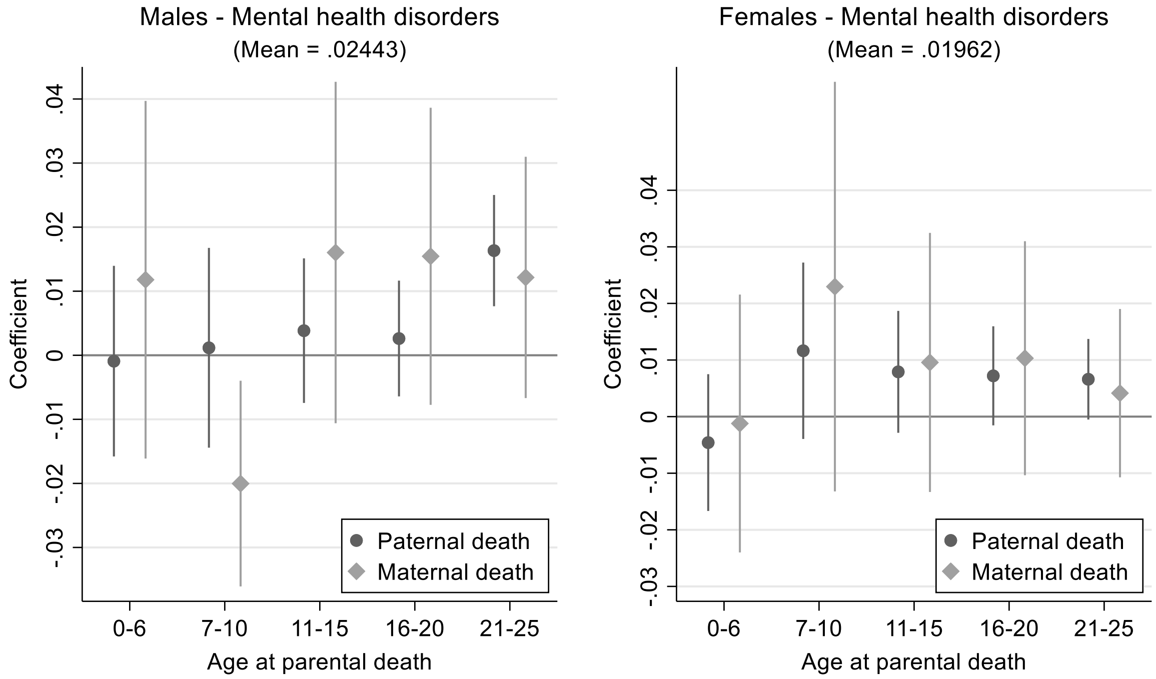
Table C1: Leading Informative and Uninformative Causes of Death

Informative Causes of Death (ICOD)		P-value on F-test that the estimates are jointly zero			
	Mortality rate	Father education	Mother education	Family income	All
Death of a Father					
Ischaemic heart diseases	15.367	0.000	0.000	0.001	0.000
Suicides	10.917	0.000	0.000	0.000	0.000
Alcohol-related diseases and accidental poisoning by alcohol	10.141	0.000	0.069	0.342	0.000
Malignant neoplasm of larynx, trachea, bronchus and lung	3.231	0.000	0.000	0.091	0.000
Other malignant neoplasms	2.900	0.000	0.000	0.001	0.000
Death of a Mother					
Malignant neoplasm of breast	4.242	0.004	0.000	0.000	0.000
Suicides	2.693	0.537	0.530	0.000	0.004
Alcohol-related diseases and accidental poisoning by alcohol	2.473	0.042	0.000	0.000	0.000
Other malignant neoplasms	2.303	0.059	0.000	0.584	0.000
Cerebrovascular diseases	2.115	0.063	0.002	0.001	0.000

Uninformative Causes of Death (UCOD)		P-value on F-test that the estimates are jointly zero			
	Mortality rate	Father education	Mother education	Family income	All
Death of a Father					
Cerebrovascular diseases	4.409	0.349	0.671	0.849	0.787
Other heart diseases excl. rheumatic and alcohol-related	2.502	0.136	0.708	0.640	0.511
Accidental falls	2.134	0.113	0.227	0.777	0.303
Diabetes mellitus	0.921	0.844	0.132	0.428	0.364
Event of undetermined intent	0.753	0.533	0.471	0.291	0.444
Death of a Mother					
Land traffic accidents	1.021	0.556	0.397	0.114	0.198
Malignant melanoma of skin	0.296	0.378	0.317	0.051	0.075
Malignant neoplasm of rectum, anus and anal canal	0.258	0.375	0.309	0.707	0.553
Malignant neoplasm of kidney	0.232	0.133	0.480	0.788	0.497
Primary malignant neoplasm of liver and intrahepatic bile ducts	0.224	0.415	0.194	0.551	0.585

Notes: The top five CODs' mortality rates are given. Mortality rate is measured as number of deaths per 1,000 individuals.

Figure C1: Cross-Sectional Linear Probability Model for Hospitalization at Ages 26–30, Uninformative Causes of Death (Males and Females)



Notes: Figure reports coefficient estimates together with 95% confidence intervals (based on robust standard errors). Comparison group is the individuals without parental death by age 30. Coefficients are for uninformative causes of deaths. Model also include unreported coefficients for informative causes of deaths.

APPENDIX D. TABLES AND FIGURES: CROSS-SECTIONAL ANALYSIS

Table D1: Mean Values by Parental Death, Cross-Sectional Analysis

Parental death	No parental death by age 30	Father's death by age 30	Mother's death by age 30
Dependent variables			
Hospitalization spell due to mental health disorders (0/1; ages 26–30)	0.0202	0.0327	0.0368
Hospitalization spell due to depression (0/1; ages 26–30)	0.00539	0.0081	0.0099
Hospitalization spell due to anxiety (0/1; ages 26–30)	0.00202	0.0031	0.0035
Hospitalization spell due to substance-use disorder (0/1; ages 26–30)	0.00553	0.0122	0.0134
Hospitalization spell due to intentional self-harm (0/1; ages 26–30)	0.00332	0.0065	0.0076
Hospitalization day visit due to mental health disorders (0/1; ages 27–30)	0.0483	0.0653	0.0735
Mental health-related death (0/1; ages 26–30)	0.000158	0.0049	0.0054
Using mental health-related prescription drugs (0/1; ages 29–30)	0.0943	0.116	0.125
Reimbursed sickness absence days, days per annum (cont. variable; ages 26–30)	2.116	2.700	2.812
Sick leave due to mental health disorders (0/1; age 30)	0.0141	0.0184	0.0224
Years of schooling (by age 30)	13.60	12.85	12.86
Annual earnings (ages 26–30)	22.68	19.81	19.94
Employment rate (ages 26–30)	0.761	0.697	0.693
Independent variables			
Female (0/1)	0.487	0.491	0.486
Language Finnish (0/1)	0.947	0.960	0.956
Language Swedish (0/1)	0.0516	0.0390	0.0428
Other Language (0/1)	0.0013	0.0010	0.0012
Lived with father at childhood (0/1)	0.923	0.821	0.870
Lived with mother at childhood (0/1)	0.971	0.961	0.918
Father has only basic education (0/1)	0.364	0.516	0.452
Father has upper secondary educ. (0/1)	0.376	0.318	0.342
Father has tertiary education (0/1)	0.260	0.166	0.206
Mother has only basic education (0/1)	0.368	0.473	0.491
Mother has upper secondary educ. (0/1)	0.391	0.358	0.328
Mother has tertiary education (0/1)	0.241	0.169	0.181
Father completed high school (0/1)	0.181	0.096	0.138
Mother completed high school (0/1)	0.257	0.177	0.174
Father's taxable income percentile (0–1)	0.592	0.556	0.583
Mother's taxable income percentile (0–1)	0.572	0.561	0.551
Father has been hospitalized due to mental health disorder (0/1)	0.0329	0.133	0.074
Father has been hospitalized due to WAAC (0/1)	0.0140	0.0913	0.045
Mother has been hospitalized due to mental health disorder	0.0247	0.0491	0.114

(0/1)			
Mother has been hospitalized due to WAAC (0/1)	0.00391	0.0135	0.0413
Mother's age at child birth (0/1)	27.12	28.69	29.23
No. of siblings w/ same mother (0/1)	2.120	2.007	2.058
Father missing (0/1)	0.0166	0	0.0553
Mother missing (0/1)	0.00166	0.0353	0
Number of individuals	818,923	112,280	41,840

Notes: Data also include indicator variables for birth year (1971–86), birth region (19 regions) and parents' occupation (9 categories for father and mother). Parents' income has been measured in 1970 & 1975 if the birth year is 1971–75, in 1975 & 1980 if it is 1976–81, and 1980 & 1985 if it is 1981–86. WAAC = Wholly alcohol-attributable conditions. Parents' hospitalization outcomes measured by child's age 9. Paternal (maternal) figures exclude individuals without missing information on the father (mother).

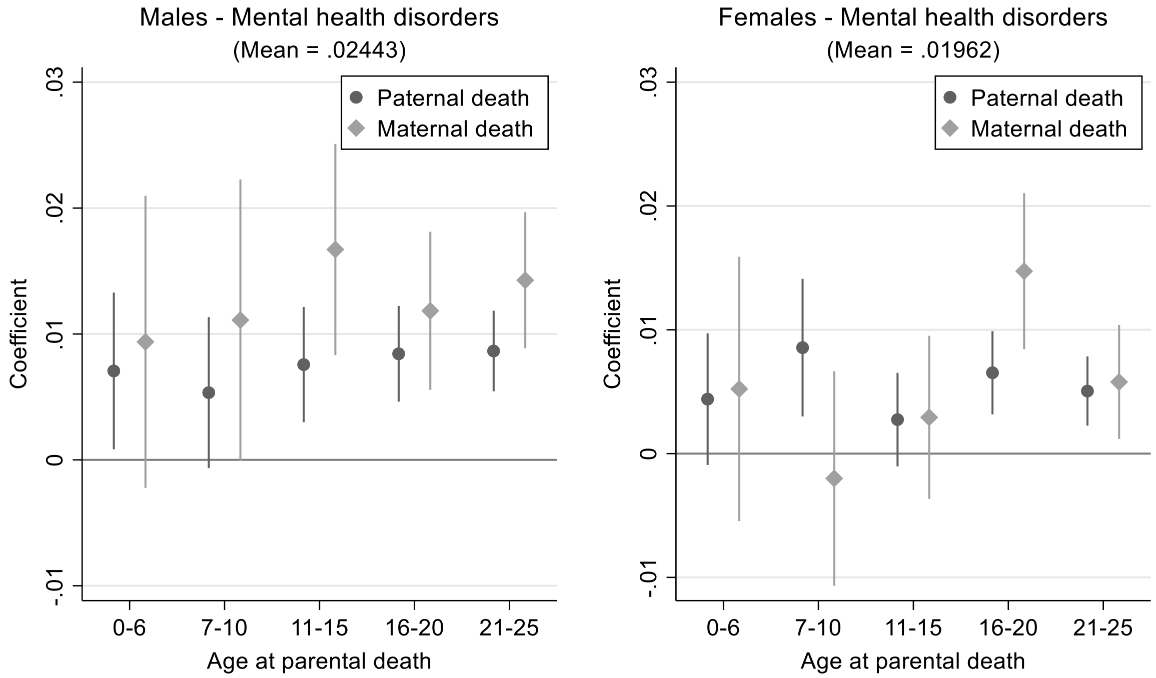
Table D2: Cross-Sectional Linear Probability Model, Hospitalization at Ages 26–30

	Males (1)	Males (2)	Females (3)	Females (4)
Age 0–6 at paternal death	0.0196***	0.0071**	0.0122***	0.0044
	(0.0031)	(0.0032)	(0.0027)	(0.0027)
Age 7–10 at paternal death	0.0144***	0.0053*	0.0140***	0.0086***
	(0.0031)	(0.0031)	(0.0028)	(0.0028)
Age 11–15 at paternal death	0.0147***	0.0076***	0.0071***	0.0027
	(0.0023)	(0.0023)	(0.0019)	(0.0019)
Age 16–20 at paternal death	0.0136***	0.0084***	0.0098***	0.0065***
	(0.0019)	(0.0019)	(0.0017)	(0.0017)
Age 21–25 at paternal death	0.0128***	0.0086***	0.0075***	0.0051***
	(0.0016)	(0.0016)	(0.0014)	(0.0014)
Age 26–30 at paternal death	0.0111***	0.0081***	0.0064***	0.0045***
	(0.0014)	(0.0014)	(0.0012)	(0.0012)
Age 0–6 at maternal death	0.0175***	0.0094	0.0134**	0.0052
	(0.0059)	(0.0059)	(0.0054)	(0.0054)
Age 7–10 at maternal death	0.0198***	0.0111*	0.0040	-0.0020
	(0.0057)	(0.0057)	(0.0044)	(0.0044)
Age 11–15 at maternal death	0.0229***	0.0167***	0.0071**	0.0029
	(0.0043)	(0.0043)	(0.0034)	(0.0034)
Age 16–20 at maternal death	0.0164***	0.0118***	0.0179***	0.0147***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)
Age 21–25 at maternal death	0.0182***	0.0143***	0.0085***	0.0058**
	(0.0028)	(0.0028)	(0.0024)	(0.0023)
Age 26–30 at maternal death	0.0171***	0.0139***	0.0072***	0.0047**
	(0.0024)	(0.0023)	(0.0020)	(0.0019)
Swedish language		-0.0084***		-0.0067***
		(0.0010)		(0.0009)
Other native language		-0.0106*		-0.0104**
		(0.0057)		(0.0052)
Mother's age at child birth		-0.0001**		0.0000
		(0.0001)		(0.0000)
Lived with father at childhood		-0.0093***		-0.0069***
		(0.0011)		(0.0010)
Lived with mother at childhood		0.0029		-0.0035**
		(0.0018)		(0.0017)
Father completed high school		-0.0007		0.0004
		(0.0007)		(0.0007)
Mother completed high school		-0.0010		0.0007

		(0.0006)		(0.0006)
Father has upper secondary educ.		-0.0018***		-0.0002
		(0.0005)		(0.0005)
Father has tertiary education		-0.0011		-0.0014**
		(0.0008)		(0.0007)
Mother has upper secondary educ.		-0.0039***		-0.0019***
		(0.0006)		(0.0005)
Mother has tertiary education		-0.0033***		-0.0019***
		(0.0008)		(0.0007)
Father's income quartile 1/4		-0.0053***		-0.0042***
		(0.0010)		(0.0009)
Father's income quartile 2/4		-0.0082***		-0.0064***
		(0.0011)		(0.0010)
Father's income quartile 3/4		-0.0103***		-0.0066***
		(0.0011)		(0.0010)
Mother's income quartile 1/4		-0.0012		-0.0008
		(0.0009)		(0.0008)
Mother's income quartile 2/4		-0.0042***		-0.0043***
		(0.0009)		(0.0008)
Mother's income quartile 3/4		-0.0055***		-0.0053***
		(0.0010)		(0.0009)
Father has been hospitalized due to mental health disorder		0.0215***		0.0215***
		(0.0019)		(0.0019)
Father has been hospitalized due to WAAC		0.0067**		0.0067**
		(0.0027)		(0.0027)
Mother has been hospitalized due to mental health disorder		0.0349***		0.0349***
		(0.0021)		(0.0021)
Mother has been hospitalized due to WAAC		0.0037		0.0037
		(0.0047)		(0.0047)
No. of siblings w/ same mother		0.0007***		0.0006***
		(0.0002)		(0.0002)
Observations	494,332	494,332	470,601	470,601
R-squared	0.0026	0.0087	0.0009	0.0050
Controls	NO	YES	NO	YES
Mean hospitalization rate	0.0244	0.0244	0.0196	0.0196

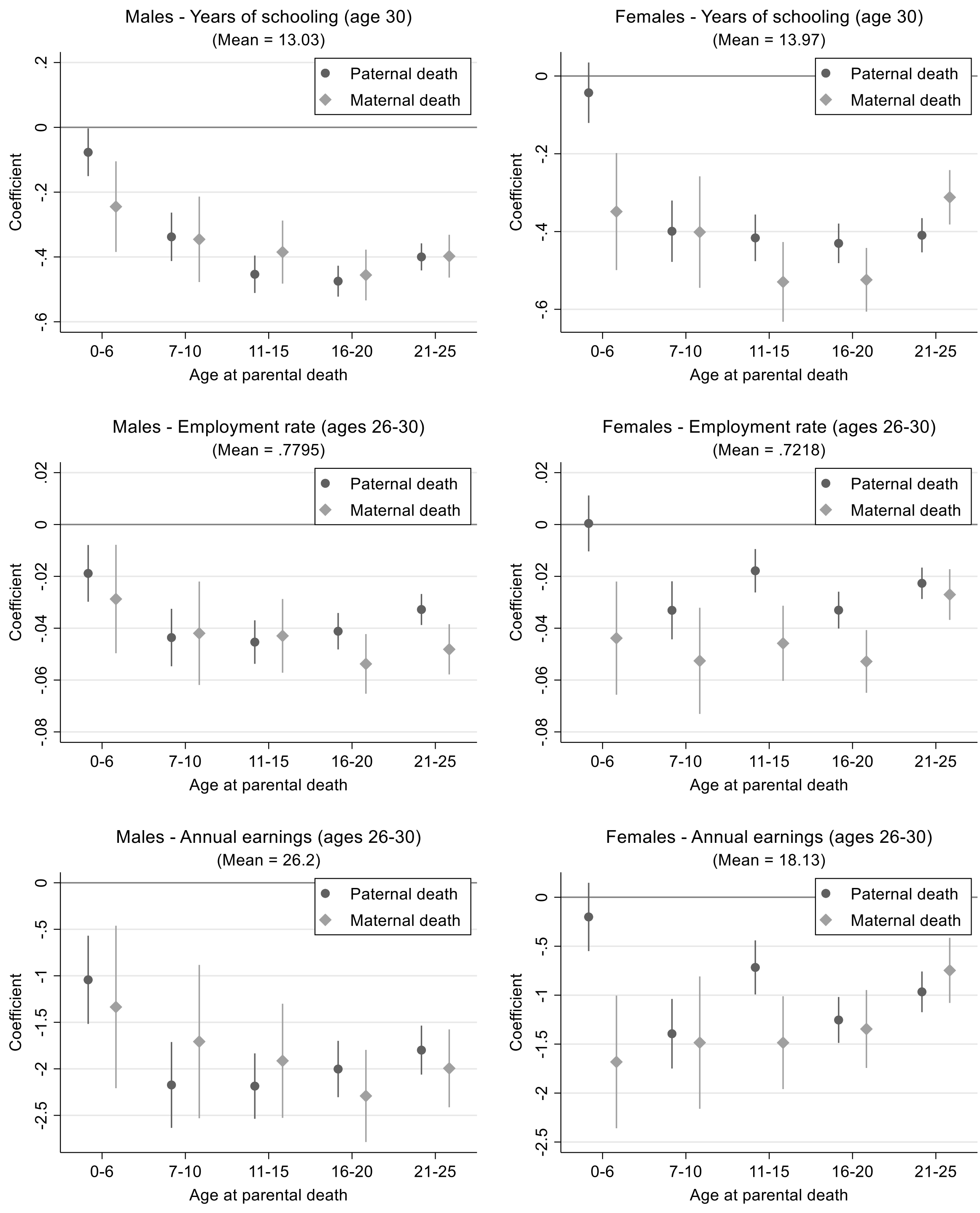
Notes: Outcome variable is a dummy for having at least one hospitalization spell due to mental health disorders at ages 26–30. Robust standard errors in parentheses. All regressions also contain controls for birth year, birth region, parents' occupation (9 categories for father and mother), unknown father and unknown mother.
*** p<0.01, ** p<0.05, * p<0.1 (for two-sided tests).

Figure D1: Cross-Sectional Linear Probability Model for Hospitalization at Ages 26–30



Notes: Figure reports coefficient estimates together with 95% confidence intervals (based on robust standard errors). Full regression results are reported in Table D2 (columns 2 and 4). Comparison group is the individuals without parental death by age 30.

Figure D2: Cross-Sectional Linear Probability Model, Education and Labour Market Outcomes (Males and Females)



Notes: Figure reports coefficient estimates together with 95% confidence intervals based on robust standard errors. Model specification is the same as in Appendix Table D2 (with controls). Comparison group is children born in 1971–86 without parental death by age 30.