Survivors' Mental Health and the Protective Role of Income Stability*

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We use administrative records on the universe of Danish households to characterize survivors' mental health following their spouse's death. We provide visually clear evidence for the immediate, large, and lingering adverse impacts and focus on studying the role of income security in driving the immediate effects. We find that, for both males and females, a large share of the spike in the takeup of mental health medication upon spousal death can be explained by the degree of income loss imposed by the shock. Safety-net policies can improve survivors' mental health with the immediate financial relief from the liquidity they provide.

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1. Introduction

The death of a spouse is one of the most devastating events that households eventually experience and, accordingly, the mental health declines of surviving spouses have been a key object of interest in economics, psychology, and health sciences.[1] While adverse mental health effects of a spousal death are inevitable, we still know very little about potentially effective ways to mitigate them. A natural question is how financial stability impacts the survivor's mental health: specifically, we ask what is the degree to which the financial loss imposed by the shock is a driving factor beyond the bereavement itself? To the best of our knowledge, no prior work has been able to assess the role of income stability in shaping survivors' adverse health effects. More broadly, there is limited work in the context of developed economies on the role of income security in mental health effects following severe adverse household events.[2]

Investigating the role of income stability in driving surviving spouses' mental health requires healthcare data (to identify death events and analyze mental health outcomes), information on household linkages (to identify couples), and rich financial information with comprehensive measures of household income (to accurately measure households' effective degree of income security). In this paper, we leverage administrative individual-level data in the Danish context, which offers this set of necessary elements for the universe of households over the years 1995-2018. We study the takeup of mental health

[1]Studies have primarily analyzed mortality and healthcare usage following spousal death by, e.g., comparing widowed households to married households in a variety of settings, including Kraus and Lilienfeld (1959), Parkes (1964a), Parkes et al. (1969), Mellström et al. (1982), Kaprio et al. (1987), Stroebe and Stroebe (1987), Bowling (1994), Martikainen and Valkonen (1998), Manor and Eisenbach (2003), Wittstein et al. (2005), Espinosa and Evans (2008), Elwert and Christakis (2008), Jones et al. (2010), van den Berg et al. (2011), Oksuzyan et al. (2011), Schultze-Florey et al. (2012), Shah et al. (2012), Simeonova (2013), Shah et al. (2013), Moon et al. (2013), Sullivan and Fenelon (2014), Stahl et al. (2016), Prior et al. (2018), Tseng et al. (2018), Blanner et al. (2020), Östergren et al. (2022), and Katsiferis et al. (2022, 2023), where reviews can be found in Stroebe et al. (1981), Moon et al. (2011), Shor et al. (2012, 2013), Ennis and Majid (2021), and Cunningham et al. (2025). Similar papers that study associations analyze a variety of mental health measures (medication, symptoms/prevalence of mental illness, suicide rates, life satisfaction), including Parkes (1964b), Turvey et al. (1999), Lindeboom et al. (2002), Luoma and Pearson (2002), Clark et al. (2008), Ajdacic-Gross et al. (2008), Taylor et al. (2008), O'Connor (2010), Frijters et al. (2011), Sasson and Umberson (2014), McCann et al. (2014), Moriarty et al. (2015), Siflinger (2017), Lundorff et al. (2020), Chen et al. (2020), Domingue et al. (2021), and Einiö et al. (2023), where reviews can be found in Stroebe et al. (2007), Kristiansen et al. (2019), and Niino et al. (2025).

[2]One recent important study on health outcomes more broadly is Gelber et al. (2023), who use a regression kink design to show that higher payments from US Social Security Disability Insurance reduce mortality of beneficiaries. Relatedly, important work highlights the role of health insurance in improving mental health (e.g., Cuellar and Markowitz 2007, Finkelstein et al. 2012, Lang 2013, Ayyagari and Shane 2015, Kruse et al. 2022).

medication among individuals whose spouse experienced a fatal health event over a horizon of four years before and after the event. We first provide new estimates for the immediate and longer-run effects of spousal death on survivors' mental health, whose careful identification and quantification (using rich, accurate, high-frequency data) has been absent in prior work. This analysis sets the stage for our main investigation of the role of economic vulnerability in the adverse health impacts and the degree to which income stability can help improve survivors' mental health. Since the baseline takeup of mental health medication is meaningfully higher among females (as we show below) and since gender is highly correlated with the income loss imposed by the shock (e.g., due to household specialization norms), we conduct the analysis separately for male and female surviving spouses to isolate the direct role of gender.

To estimate dynamic causal effects on survivors' mental health, we follow our previous work in Fadlon and Nielsen (2019, 2021) and compare the outcomes of "treated" survivors to an explicit control group of households that experience the same types of shocks a few years later. Our analysis is therefore not subject to potential challenges involved in having units that switch in and out of experimental arms as posed by recent work (De Chaisemartin and d'Haultfoeuille, 2024). Our setup provides a clean dynamic difference-in-differences design relying on the assumption that the exact timing of health events could be as good as random. To meet this assumption, our analysis focuses on households in which one partner experiences a heart attack or stroke for the first time in our hospitalization data and dies within the first year of this event. We document that spousal death has large, immediate, and lingering mental health effects. Takeup of mental health medication more than doubles, from a baseline of 10 percentage points (pp) in the first month after the event. Even four years after spousal death, takeup remains over 15% higher relative to the counterfactual for both males and females.

Our core investigation studies the role of income security in driving these effects. We focus on the degree of income loss imposed by the spousal death. Specifically, we use the percent of overall household income lost from a year before to a year after the shock, holding constant potential adjustments in spousal labor supply or benefit takeup that we show to respond to the event in prior work (Fadlon and Nielsen, 2021). To isolate remaining variation in income that could be affected by the treatment, we instrument using the share of household income earned by the deceased spouse in the baseline year.

This analysis proceeds in two steps. First, for each gender, we provide dynamic figures for the takeup of mental health medication around spousal death, comparing households in which the deceased was an earner to households in which the deceased did not have any earnings. We find that households with deceased earners experience larger income losses and have additional mental health declines in the year of the event. The short-lived nature of these differentials suggests that liquidity effects, rather than permanent income effects, govern the variation of the mental health effects in the degree of income loss.

Second, we analyze regressions in which the outcome variable is the spouse's take-up of mental health medication upon the event that quantify the role of income stability. The key right-hand side variable is household income loss instrumented by the share of household income earned by the deceased. A key limitation of our heterogeneity analysis is its correlational nature, so we add a wide range of interactions to further isolate the partial correlation with income loss. Specifically, we include interactions of the difference-in-differences parameter with the following characteristics of the survivor at baseline: children indicators, household income, age, geography, education, indicators for psychiatric treatment or hospitalization, length of the couples' relationship, and indicators for marriage vs. cohabitation. For both genders, the coefficient on the household's income loss hardly changes when including the rich controls.

We find that both male and female survivors exhibit higher immediate increases in the takeup of mental health medication when they lose an earning spouse. The magnitudes of these differentials are larger for females, but women who lose an earning spouse also experience larger income losses. Indeed, the regressions show similar sensitivity to comparable income losses across gender (with higher point estimates for males). In terms of magnitudes, females exhibit an average treatment effect of 20.2pp and a one-standard-deviation decline in household income loss (17pp) is associated with a reduction of 5pp in the treatment effect. In a counterfactual that eliminates the average income loss (of 40pp), the average treatment effect would be reduced by 60% (=12pp/20.2pp). The magnitudes are somewhat larger for males. Our findings therefore point to an important role for income stability in driving the mental health declines upon a spousal death. Accordingly, policies that aim to reduce financial uncertainty among survivors can also lead to important welfare effects via improved mental health from the liquidity they provide. While intuitive, clear results that provide evidence in support of this conjecture have so

far been absent from the literature.

2. Institutions, Data Sources, and Variable Definitions

Institutions. In the context of fatal health events and the associated income loss, two types of institutions are relevant to consider: healthcare and safety-net programs for income security. In our setting, Denmark, healthcare is financed through a single-payer, tax-funded, universal scheme that provides free access for all residents (Birk et al., 2024). The universal coverage enables us to document mental health effects of spousal death that are not confounded by access to or affordability of care. Important for our analysis, prescription drugs are heavily subsidized (Danish Medicines Agency, 2019). Annual out-of-pocket spending on psycholeptics and psychoanaleptics, which constitute our main outcome of interest, average to only DKK 375 (US$50) for those who consume any of these drugs in the year of the spousal death. In Fadlon and Nielsen (2021), we describe the income security means relevant for our context: Social Security (DI and OAP with eligibility ages at 65 or 67); additional government income assistance programs (e.g., sick pay and early retirement from age 60); and privately-purchased insurance policies. Furthermore, about 75% of the Danish labor market is covered by group-market pension policies that include mandated defined-contribution retirement plans and life insurance. If a beneficiary dies before retirement, the surviving spouse automatically receives pension annuities, which show up in our data in the survivor's tax records. These programs and policies are broadly similar to those in other developed countries, and we describe in Appendix A their main institutional features and benefit schedules. Importantly, Denmark does not have an explicit survivors' benefit scheme, in contrast to the US Social Security.

Data Sources. We use administrative individual-level data, with family linkages, covering detailed information on demographics, income, and healthcare utilization for the entire Danish population from 1995 to 2018. We construct our main sample from the Population Registry (Statistics Denmark, 2024a) with yearly observations on individuals' demographic characteristics starting in 1980. Crucially, family linkages enable us to identify partners (married or cohabiting) and children. To identify fatal health events, we use two complementary registries: i) the Death Registry (Statistics Denmark, 2024b) that includes death dates from 1970 onwards, ii) the National Patient Registry (Statistics

Denmark 2024d, Statistics Denmark 2024e) with consistently measured records on all visits to (public or private) hospitals from 1980-2018. Data include admission dates, location, and diagnoses (using ICD system, WHO (2019)).

We merge information from the Income Registry (Statistics Denmark, 2024c), available from 1980, containing annual flows of all sources of income, including earnings, government transfers from all programs (e.g., DI, sick pay, early retirement, OAP, and unemployment insurance), payouts from retirement savings accounts, payouts from insurance companies, and capital income.

To obtain information on mental health, we use the Pharmaceutical Database (Statistics Denmark, 2024f), containing information on prescription pick-up dates and ATC codes (WHO, 2022) of all prescription drugs purchased from pharmacies in Denmark from 1995 onward.

Variable definitions. We operationalize our analysis using three main definitions. First, we define the event of a fatal health shock, which we from now on refer to as the "death event." We focus on heart attacks and strokes, which are commonly studied as likely sudden and severe events whose timing is less likely to be expected (Chandra and Staiger 2007, Doyle 2011, Fadlon and Nielsen 2019, 2021). We identify an index event as the first time a spouse experiences one of these health shocks in our hospitalization database. We then restrict the sample to fatal events, specifically, events in which the spouse dies within twelve months of the index admission.[3] We index the calendar year of the shock as year 0, denoted by $r = 0$.

Second, we define our mental health outcome based on redeemed prescriptions for psychotropic drugs, specifically those classified as psycholeptic (N05) and psychoanaleptic (N06) according to the ATC system (more than 99% of these drugs can be linked directly to the consumer). As we group broad classes of mental health drugs, we focus on the extensive margin of the survivor's consumption, which indicates a broad demand for mental health medication (rather than the narrower medical treatment of a specific symptom). The high frequency of these data allows us to study outcomes at both monthly and annual levels. From now on we refer to the responses in this variable as the impacts on "mental health." We note the caveat that the observed responses in the takeup of mental health medication will also reflect the diagnostic process and the surviving spouses' de-

[3]In Appendix Figure B.3, we run a robustness check where we restrict the sample to cases in which the cause of death matches the heart attack/stroke event. The results remain unchanged.

cision to seek care (Henriksson et al., 2006, Ohayon, 2007, Kivimäki et al., 2007, Thielen et al., 2009). Furthermore, there may be a provider effect, as evidenced by the work on physician practice styles and patient healthcare utilization (e.g., Fadlon and Van Parys 2020; Albertini, Bakx, and Mazzonna 2024).

Third, for our key analysis of the role of income stability, we define a measure of "household income loss imposed by the shock." We measure annual losses using the change in household income from the last full year before the shock ($r = -1$) to the first full year after the shock ($r = 1$). The main components of household income are labor earnings (37%); payments from DI and OAP (28%); and payments from retirement plans (17%). From our prior work in Fadlon and Nielsen (2021), we know that widows respond to large income losses by increasing labor supply and applying for social pensions. To account for such behavioral responses that would directly bias our income loss measure, we adjust the income measure in the post-event year to hold constant the surviving spouse's labor income and social pensions at their levels in period $r = -1$. Specifically, we define

$$\begin{aligned} \textit{Household Income}_{i,r}^{Adjusted} \equiv & \textit{Household Income}_{i,r} + (\textit{Earnings}_{i,-1}^{survivor} - \textit{Earnings}_{i,r}^{survivor}) \\ & + (\textit{Social Pensions}_{i,-1}^{survivor} - \textit{Social Pensions}_{i,r}^{survivor}), \end{aligned}$$

where $\textit{Household Income}_{i,r}$ is the realized income. Appendix Figures B.4-B.6 provide a breakdown of household income in the year before and after the event into seven different income components and their attribution to either the surviving or the deceased spouse. It splits the sample by the gender of the surviving spouse and the employment status of the deceased spouse at baseline. We define the relative change in our household income measure from before to after the event as "the household income loss imposed by the shock" as follows:

$$\textit{Household Income Loss}_i \equiv \frac{\textit{Household Income}_{i,1}^{Adjusted} - \textit{Household Income}_{i,-1}}{\textit{Household Income}_{i,-1}}$$

where $\textit{Household Income}_{i,r-1}$ is total household income at baseline. Finally, we isolate the remaining variation in income that could be affected by the treatment by instrumenting household income loss with the share of household income earned by the deceased

spouse in the baseline year ($r = -1$). Our instruments will be functions of the share $\frac{Earnings_{i,-1}^{\text{Deceased}}}{Household\ Income_{i,-1}}$. In Appendix Figures and Tables B.4-B.6 we see that the deceased's earnings made up 44% of the household's income loss (=DKK 54.7k/123.3k). Among households in which the deceased spouse had earnings, which are naturally younger, the deceased's earnings made up 97% of the income loss (=DKK 187.9k/194.5k). These numbers are indicative of a strong first stage which we return to in the results section.

3. Research Design

3.1 Dynamic Effects of Spousal Death

Quasi-Experiment. To mimic an experimental ideal that compares ex ante similar couples that do and do not experience a spousal death, we take the approach we developed in Fadlon and Nielsen (2019, 2021). Specifically, we consider only couples who experience a spousal death at some point in our sample period and identify the treatment effect based on the timing of the death event. We construct counterfactual outcomes for affected households based on couples from the same cohorts that experience the same event but a few years later. Our treatment group is composed of individuals whose spouse experiences a fatal health event in year τ, and our control group is composed of individuals whose spouse experiences a fatal health event in year $\tau + \Delta$, to whom we assign a placebo event in year τ. We identify the treatment effect by comparing changes in outcomes across these two experimental groups over time through traditional event studies, which we combine into a straightforward dynamic difference-in-differences estimator.

We normalize the time of observation such that period r is measured with respect to the assigned event year; that is, $r = year - \tau$, where $r = 0$ is when the assigned event occurs. Our analysis of monthly frequency uses a similar normalization but around the month of the health event. We estimate the dynamic effects of spousal death on mental health, separately for males and females, using the following estimating equation:

$$y_{i,r} = \alpha_i + \sum_{r \neq -1, r=-4}^{r=4} \gamma_r \times I_r + \sum_{r \neq -1, r=-4}^{r=4} \delta_r \times I_r \times Treat_i + \lambda X_{i,r} + \varepsilon_{i,r}, \qquad (1)$$

where $y_{i,r}$ denotes an indicator for the takeup of mental health medication by the surviving spouse in household i in period r around the event; $Treat_i$ denotes an indicator for

household i belonging to the treatment group; I_r denotes indicators for time relative to the index health event (the actual event among the treatment group and the placebo event among the control group); α_i is a vector of household fixed effects; $X_{i,r}$ is a vector of controls including year fixed effects (which absorb potential time trend in medication consumption) and a quadratic in the surviving spouse's age; and $\varepsilon_{i,r}$ is the idiosyncratic error term. The coefficients of interest are δ_r, which measure the mental health effect of spousal death in period r relative to the baseline period -1.

Analysis Sample. Our sample consists of individuals whose spouse was hospitalized with a heart attack or stroke and died within the next 12 months. We define couples based on marriage or cohabitation as of five years prior to the health event to freely allow for changes in marital status. We keep households in which both spouses are Danish residents and aged 45-80 in the year of the index event. We exclude self-employed individuals as the data only contain information on wages and net profits, leaving us with an incomplete picture of their income changes around the event. We balance the sample from four years before to four years after the index event.[4] Appendix Table B.1 summarizes statistics on key variables for both spouses in our analysis samples.

Validation Exercises. The identifying assumption is that, absent the spousal death, the mental health outcomes of the treatment and control groups would have followed the same trend in the post-period. The credibility of this assumption builds upon the conjecture that within a time window of Δ the specific year of spousal death is as good as random. We assess the validity of this common trends assumption through differences in trends in the pre-period. We visually illustrate the two groups' behavior in the four years before the index event based on raw data and we formally test if $\delta_r = 0$ for all $r < 0$ based on regression estimates of equation (1) that includes controls. We demonstrate that parallel pre-trends tightly hold across all specifications and sample splits in support of our design.

When choosing Δ, we face a trade-off between household similarity (which is declining in Δ) against analysis horizon (which is increasing in Δ). Our choice in the analysis is $\Delta = 5$, which provides comparable treatment and control groups (as evidenced by closely parallel pre-trends) and allows us to identify effects up to four years after the spousal

[4]This implies that our sample comprises of surviving spouses not dying within this period. Appendix Table B.2 replicates the main analysis on an unbalanced sample, including surviving spouses who are in the sample for any number of periods within the nine-year analysis horizon. The results remain similar using these specifications.

death (because the control group experiences an actual event and becomes "treated" Δ years after the treatment group). Appendix Table B.3 replicates the analysis by varying Δ from 3 to 7 and shows the robustness of our findings to this choice (where Appendix Figure B.8 provides the visualization of this exercise).

We note that since the same household may by design appear in both the treatment and the control groups (but can never be a control unit to itself), we cluster standard errors at the household level. Appendix Table B.3 repeats our main analysis using non-overlapping treatment and control households by randomizing households to appear only in one experimental group with similar findings.

3.2 Heterogeneity

We then investigate the degree to which the financial burden imposed by the shock amplify these effects. In our prior work, we show how spousal labor supply responses to a death shock can be fully explained by the degree of income loss imposed by this shock (Fadlon and Nielsen 2021), and Coyne et al. (2024) reach similar conclusions in the context of the US. This motivates our key investigation of the role of income stability in analyzing the heterogeneity in mental health effects upon a spousal death.

To assess the heterogeneity in treatment effects, we estimate the following difference-in-differences specification:

$$y_{i,r} = \alpha_i + \gamma Post_r + \delta Treat_i \times Post_r + \phi_d Treat_i \times Post_r \times D_i + \lambda X_{i,r} + \varepsilon_{it}, \quad (2)$$

where $Post_r$ is an indicator for observations belonging to the post-period. The vector D_i can capture any household characteristic, where our key dimension of interest is the household income loss imposed by the shock. The vector $X_{i,r}$ additionally includes $Post_r \times D_i$ interactions when D_i is also relevant for the control group (such as age). The parameter vector ϕ_d captures our coefficients of interest that quantify the amplifying role of the characteristics in D_i. For the estimation of ϕ_d when D_i is our key variable "household income loss" we instrument with the share of household income earned by the deceased spouse at baseline.

The income loss imposed by a spousal death involves both liquidity effects and permanent income effects. In the US, Coyne et al. (2024) find a high valuation of the liquidity

survivors benefits provide to newly-widowed household via their labor supply responses to benefit age-eligibility.[5] To help distinguish between the two types of effects, we explore the dynamics in differences across households with differential degrees of income loss in reduced-form figures splitting households by the deceased spouse's earner status at baseline. If the differentials are short-lived and concentrated on the immediate run, they would be indicative of liquidity effects; whereas if the differentials are concentrated on the medium run, they would be indicative of permanent income effects.

We include additional household characteristics in the vector D_i to investigate alternative hypotheses based on the interaction parameters ϕ_d. First, we study whether the mental health effects differ by the presence of children. Prior work highlights the role of family interactions in providing instrumental and emotional support, which may be associated with the mental health effects of spousal death (e.g., House et al. 1988, Zunzunegui et al. 2001, Golden et al. 2009 Dalton and LaFave 2017, Autor et al. 2019, Persson 2020, Marion 2023, Arrieta and Li 2023, Jensen and Zhang 2024). In our setting, having younger children may increase the stress associated with the spousal death, whereas having older children may attenuate the effects through, e.g., support from adult children or moving in with them. Second, we investigate potential heterogeneity in household income levels at baseline, which allows us to assess the role of baseline inequities. The literature on health gradients in income has focused on inequities in the incidence of adverse health, with examples such as Chetty et al. (2016) and Dahl et al. (2024) studying mortality/life-expectancy in the US and in Denmark, and Danesh et al. (2024) studying a range of health conditions in the Netherlands. In Appendix Figure B.1 we show the gradient in baseline income in our context, where we see that households with higher income tend to be in better mental health. Here, we are interested in whether higher baseline levels of income can cushion the effects of the shock. Finally, in robustness checks, we include a wide set of additional variables in D_i to further isolate the partial correlation of the treatment effect with our main characteristics of interest.

[5]Whereas the two settings can naturally differ, we show comparability across them when considering labor supply responses to spousal death and their relation to the degree of income loss imposed by the shock. Specifically, in Fadlon and Nielsen (2021) we show that in our context of Denmark, where there is no explicit survivors insurance program, widows' earnings increases following the shock are similar in magnitude to those by benefit-ineligible widows in the US as found in Coyne et al. (2024), suggesting comparability in valuations of income coverage in the two settings.

4. Empirical Evidence

4.1 Dynamic Effects

Figure 1 provides estimates for the dynamic causal effects of spousal death on the survivors' mental health. We provide estimates at both monthly and annual frequencies, separately by the gender of the surviving spouse. The panels on the left plot the raw data for the takeup of mental health medication among surviving spouses. The red line and full circles plot outcomes for our treatment group (along with the 95-percent confidence intervals), where time zero represents the month of the index event. The blue line and hollow squares plot outcomes for our control group who experience the same types of spousal events 60 months later. The panels on the right plot estimates for the effects of the death event on survivors' mental health based on equation (1). The purple line and hollow markers show results at the monthly frequency. The black circles provide estimates for annual frequency.[6] The monthly data allow us to study the immediacy of the spousal response. For persistence in the the longer run, we look at estimates at the annual level since the higher-frequency data may mask the effective magnitudes of consumption (e.g., if drug purchases are made in bulk and prescriptions are filled for consumption covering several months).

Figure 1 first provides strong support for our design, validating parallel pre-trends in outcomes across treatment and control groups in all sample splits. Second, it pinpoints the surviving spouses' sharp increases in the takeup of mental health medication following the spousal death. For both genders, we see an immediate jump in takeup in the first month of the event. The average immediate effect amounts to 12.7 percentage points (pp), corresponding to a 140% increase relative to the counterfactual in that month (9.1pp=21.8pp-12.7pp). The treatment effects then gradually decline in the 60-month period that follows the event.

At the annual level, the sharp increase in takeup of mental health medication amounts to 19.5pp in the first year, on a counterfactual of 24.1pp (=43.6pp-19.5pp). Four years later, the effects still persist at 4pp, which represent takeup that is 15% higher relative to the counterfactual in that year (27.4pp=31.4pp-4pp). Both the immediate and longer run patterns are similar across gender, with baseline levels and treatment effects that are

[6] Appendix Figure B.2 provides plots for the raw data at the annual frequency.

somewhat larger among female surviving spouses.

4.2 The Role of Income Stability

As a segue to understanding the importance of income in driving these effects, we begin by providing a descriptive illustration of the evolution of household income around family health events. In Fadlon and Nielsen (2021) we show that the reduction in income from the foregone earnings of the sick spouse in non-fatal shocks is adequately covered (primarily through DI) as opposed to the fatal health events that are our focus of analysis here, which impose large income losses. Panel B of Figure 2 illustrates this point by plotting the evolution of (adjusted) household income around the health event and the subsequent spousal death. We do so by studying households in which spouses were all hospitalized in year τ but whose death occurred with varying timing in years τ, $\tau+1$, or $\tau+2$. For all groups, we see income falling in the year of spousal death (where the full effect manifests in the first full calendar year after the death event) with no effective changes in the year of hospitalization. In Panel A of Figure 2, we extend this analysis to mirror the evolution of mental health around the fatality of the health shock. Interestingly, the degree of income loss and mental health declines go in tandem, motivating the investigation of the degree to which income loss drives the mental health effects in spousal death. Naturally, the health shocks and the subsequent death involve many other angles beyond income losses, specifically the bereavement itself.

To directly analyze the role of income loss in the mental health effects of a spousal death, we proceed with comparisons of widowed households who experience varying degrees of income loss as instrumented by the share of household income earned by the deceased. As the basis for this investigation, we assess the degree to which the share of the income earned by the deceased in period $r = -1$ is predictive of the household's income loss (that is, the first stage). Panel A of Figure 3 shows the distribution of household income loss by gender, with an average of 36% among males and 40% among females. Panel B plots household income loss as function of the instrument, separately for males and females. To visualize the distribution of households, the figures provide circles that reflect the proportion of households with a given share of household income earned by the deceased. Within gender, the figures split the instrument to 0 earnings and positive earnings, and the positive range is then split into 100 equal-sized bins. The

circles are of similar size in the positive range by construction, and the size of the circle of non-earners allows us to see the mass at 0. The patterns show two points that guide our income variation analysis: 1) for both genders, 0 is the effective median of the share of household income earned by the deceased;[7] 2) this share is highly predictive of household income loss, both when comparing earners to non-earners and when exploiting the continuous variation for earners, where we see that a quadratic provides a good fit. With this in hand, our regressions use the following instruments jointly: an indicator for earner/non-earner and a second-order polynomial in the share earned by the deceased. The F-statistics are provided on the figure for each gender.

We proceed in two steps. First, we provide dynamic figures for the surviving spouse's mental health that compare households where the deceased was an earner to households where the deceased was a non-earner. To ensure this sample split provides a good proxy for the effective income loss outside of other factors, we need to improve the match of the two comparison groups. Specifically, households in which the deceased was an earner or a non-earner differ by age (as we show in panel A of Appendix Figure B.7), and age itself is predictive of income loss even after controlling for the deceased spouse's earner status (as we show in panel B of Appendix Figure B.7, where this relationship has non-linearities in line with benefit eligibility age thresholds). We therefore match within each gender the households with non-earner deceased spouses to households with earner deceased spouses based on the age of the surviving spouse at the event (by reweighting).

Panel C of Figure 3 provides a clear visualization that, among both males and females, households with deceased earners, who experience larger income losses, also experience a larger increase in the takeup of mental health medication in the year of the event. These differentials are on the order of 31% (=5.54pp/17.8pp) among males and 41% (=8.24pp/20.2pp) among females. The dynamic patterns of the differentials are further suggestive of their source. As described in Section 3.2, our finding that, for both males and females, the differentials appear only in the year of the shock are consistent with the variation by the degree of income loss being driven by liquidity effects.

Accordingly, in the second step, we study as the outcome variable the spouse's mental health medication in year 0. This allows us to quantify the degree to which the spike we observed in the takeup of mental health medication upon the event varies with the

[7] 70% (74%) of deceased spouses did not have earnings at baseline among households with female (male) survivors.

degree of income loss, as instrumented by the share of household income earned by the deceased.

Table 1 provides estimates of ϕ_d from specifications of equation (2) using observations from periods $r = -1$ and $r = 0$. We estimate specifications for the pooled sample and for each gender separately. Columns 1, 3, and 5 provide the main specifications that include in the vector D_i household income loss (instrumented), indicators for the presence of children younger or older than 18, log household income at baseline, and a female indicator in the pooled regressions.

For both male and female surviving spouses, we find that the immediate effects on mental health exhibit similarly significant sensitivities to household income loss.[8] For male surviving spouses, who exhibit an average treatment effect of 17.8pp, a 1 standard deviation decline in household income loss (17pp) is associated with a reduction of 6pp in the treatment effect. In the counterfactual in which we eliminate the average income loss (of 36pp), we would see a reduction of 71% (=12.7pp/17.8pp) in the average treatment effect. For female surviving spouses, who exhibit an average treatment effect of 20.2pp upon the event, a 1 standard deviation decline in the household's income loss (17pp) is associated with a reduction of 5pp in the treatment effect. In the counterfactual in which we eliminate the average income loss (of 40pp), we would see a reduction of 60% (=12pp/20.2pp) in the average treatment effect. Overall, our findings point to a meaningful role for income stability in driving the sharp declines in mental health upon a spousal death. Accordingly, safety net policies of income security have potential gains from improving survivors' mental health with the immediate financial relief from the liquidity they provide.

Columns 2, 4, and 6 offer robustness checks in which we include a wide set of additional variables in D_i to further isolate the partial correlation of the treatment effect with our main characteristics of interest. These include a quadratic in the surviving spouse's age, five geographic region dummies, seven education categories, an indicator for whether the surviving spouse had a psychiatric treatment, an indicator for whether the surviving spouse had a hospitalization, an indicator for whether the couple had been married/cohabiting for 10+ years, and indicators for whether the couple was married or

[8]Moreover, the treatment effect has no correlation with gender once the degree of income loss is directly accounted for.

cohabiting.[9] The results show that the coefficients on the household's income loss hardly change when we include all these interactions for either males or females.

Finally, the partial correlations with the other household characteristics provide tests for the alternative explanations from the literature that we discussed in Section 3.2. With respect to baseline income levels, the patterns deliver the following conclusion. The combination of a baseline gradient of mental health in income (in Appendix Figure B.1) and, if anything, that the effect of spousal death is somewhat correlated positively with baseline income, implies that spousal death is devastating across the income distribution for both rich and poor households. In fact, the baseline inequality in mental health is equalized around the death event. The findings overall show that it is not the level of income that cushions the shock, but rather the relative degree of income stability when the adverse event occurs. We conclude by noting that there are no detectable correlations with either the presence of younger or adult children in our setting.

5. Conclusion

Spousal death causes large and immediate declines in the mental health of the surviving spouse, with effects that linger for at least four years. Whereas these mental health declines are overall inevitable, the literature has not yet investigated whether there are effective ways to mitigate them. We provide novel evidence that income stability has the potential to meaningfully reduce the adverse mental health declines upon a spousal death. Our analysis illustrates more broadly that the welfare gains from income security programs can come not only in the traditional form of the targeted goal of consumption smoothing but also in the form of improved mental health of significant economic magnitudes.

[9] Appendix Table B.7 reports the full set of coefficients.

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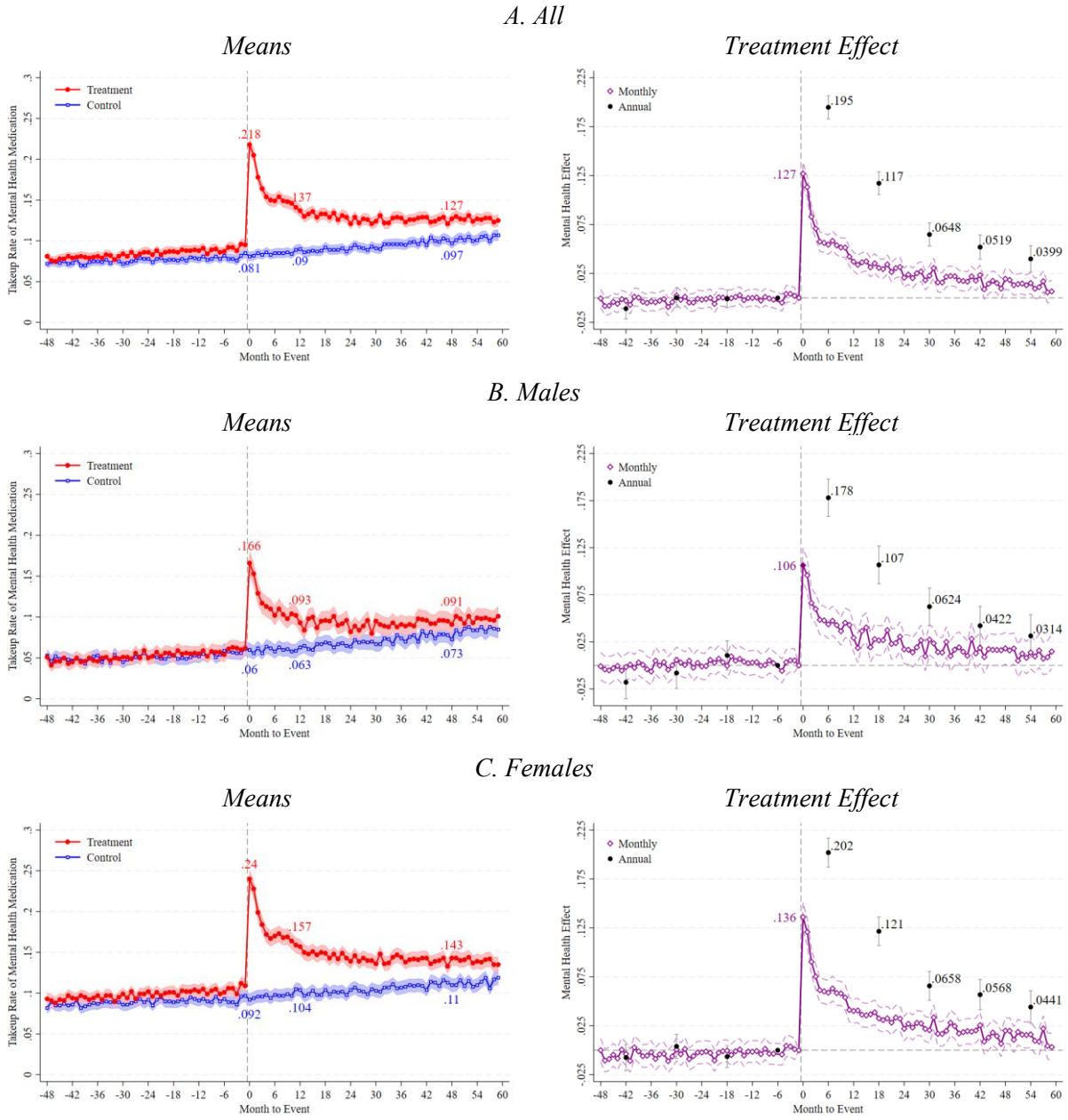
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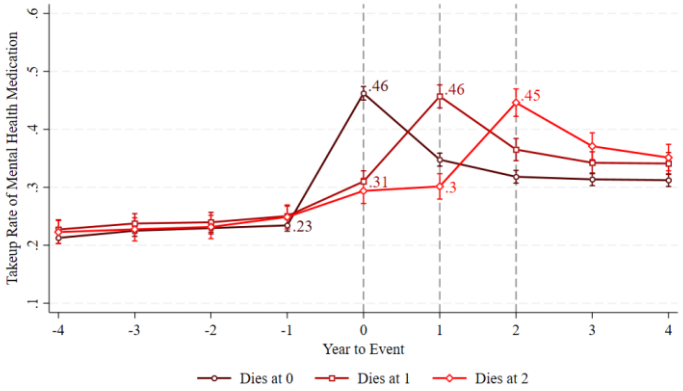
Figure 1: Takeup Rate of Mental Health Medication around Spousal Death



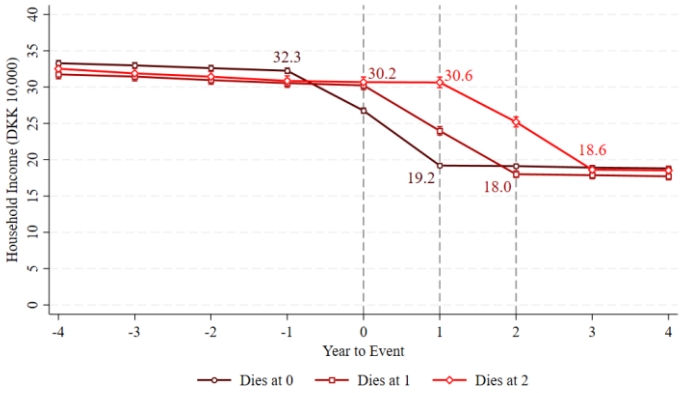
Notes: This figure studies the takeup of mental health medication around a spousal death by the gender of the surviving spouse. The treatment group consists of individuals whose spouse experiences a fatal heart attack or stroke in 1999-2013, and the control group consists of individuals whose spouse experiences a similar event but in 2004-2018 (to whom we assign a placebo event five years earlier), where we restrict the sample such that both spouses are in the age range 45-80 at baseline. The sample is balanced across the four years before and after the health event so that each household appears throughout the analysis horizon. The panels on the left show the mean takeup rate by time relative to the index event for the treatment group in red circles and for the control group in blue squares, with corresponding 95-percent confidence intervals. The panels on the right present the treatment effect of spousal death from the dynamic difference-in-differences specification in equation (1) estimated at a monthly frequency in purple along with estimates for annual frequency in black. The figures plot the estimates of δ_r along with their 95-percent confidence intervals, where the regressions include household fixed effects, time fixed effects, and a quadratic in the surviving spouse's age. The average takeup rate in month -1 and year -1 are, respectively, 0.095 and 0.235 among all households, 0.062 and 0.166 among male surviving spouses, and 0.109 and 0.266 among female surviving spouses.

Figure 2: Mental Health and Income Loss around Family Health Shocks

A. Takeup Rate of Mental Health Medication by Timing of Fatality

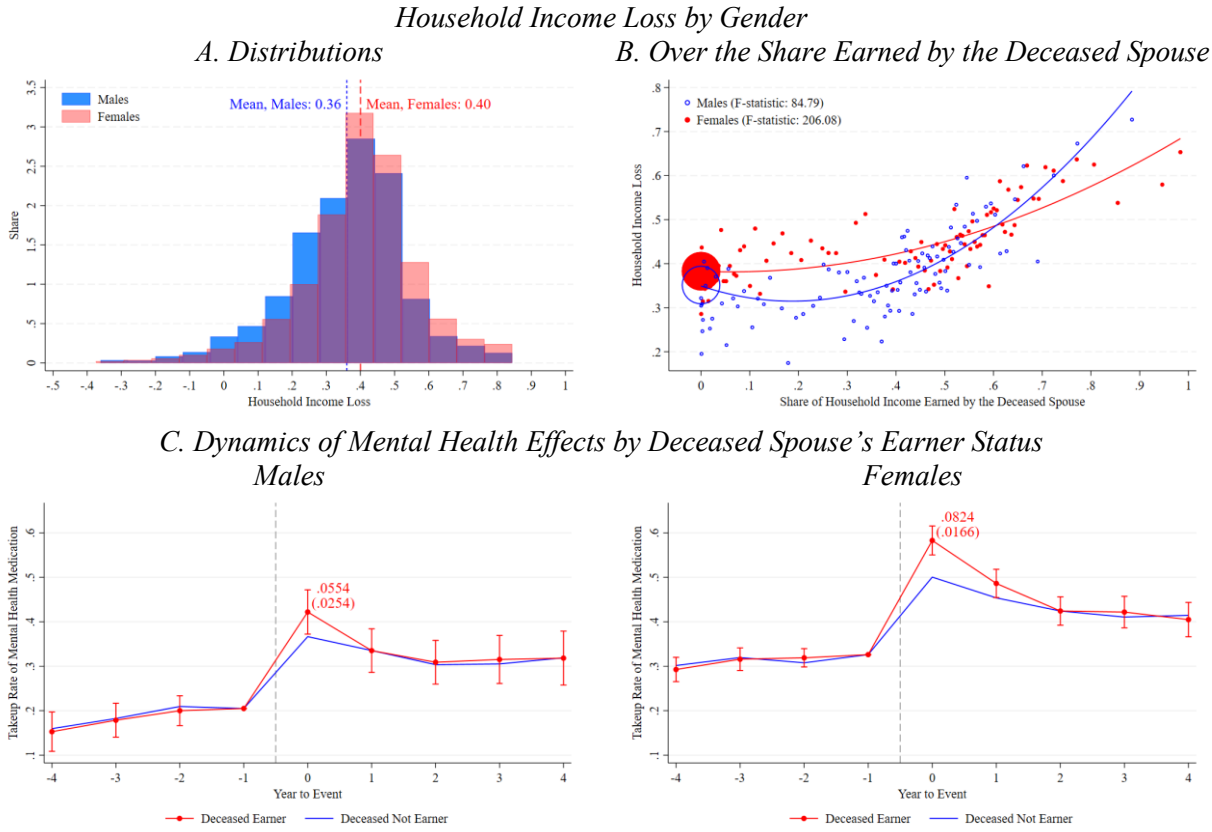


B. Household Income by Timing of Fatality



Notes: This figure shows the takeup rate of mental health medication and household income around fatal spousal health events by the time between the health event and death. The sample includes households in which one spouse experiences a heart attack or a stroke between 1999 and 2015 and dies within three years when both spouses are aged 45-80, where the sample is balanced across the four years before and after the health event. Panel A shows the mean takeup rate (with corresponding 95-percent confidence intervals) by time relative to the index event for those whose spouse dies in the same year, the next year, or two years later. Panel B shows the mean household income (with corresponding 95-percent confidence intervals) by time relative to the index event for those whose spouse dies in the same year, the next year, or two years later. Household income is adjusted such that it holds the surviving spouse's labor income, sick pay, Disability Insurance, and Old-Age Pensions fixed at their levels in the year before the event.

Figure 3: Mental Health and Household Income Loss around Spousal Death



Notes: This figure studies the relationship between the share of the household's income earned by the deceased spouse, the household's income loss, and the takeup of mental health medication by the surviving spouse. The sample includes households in which one spouse experiences a heart attack or a stroke between 1999 and 2013 and dies within 12 months when both spouses are aged 45-80 and is balanced across the four years before and after the health event. Panel A plots the distribution of the income loss imposed by the spousal death, separately by the gender of the surviving spouse. Household income is adjusted such that it holds the surviving spouse's labor income, sick pay, Disability Insurance, and Old-Age Pensions fixed at their levels in the year before the event. The household's income loss is measured as the relative change in the household's adjusted income from the year before to the year after the event, and we winsorize it at its top and bottom 1 percent. Panel B illustrates the association between the household's income loss imposed by the shock and the share of the household's income earned by the deceased spouse in the year before the event, which we use as an instrument. The graphs provide circles that are reflective of the proportion of households with a given share of the household's income the deceased earned. Within gender, the figures split the instrument to 0 earnings and positive earnings, and the positive range is then split into 100 equal-sized bins. The graphs present the F-statistic from a regression of the household's income loss on the share of household income earned by the deceased spouse (an indicator for positive earnings and a quadratic in the share), controlling for children indicators (presence of younger/adult children based on the age 18 cutoff) and the household's log income in the year before the event. Panel C provides dynamic figures for the takeup of mental health medication of the surviving spouses where we split households by the earning status of the deceased spouse in the year prior to the event. Within each gender, we match the households with non-earner deceased spouses to households with earner deceased spouses based on the age of the surviving spouse at baseline. Specifically, we reweight the households where the deceased spouse was a non-earner using the population weights calculated from the gender-specific age distribution of the households where the deceased spouse was an earner. The figures plot the takeup among spouses in households where the deceased was not an earner in blue lines, and compare it to the takeup among spouses in households where the deceased had positive earnings in red. The graphs for the latter group are constructed by adding the differentials across the two groups onto the levels for the former group, where the reported point estimates and 95-confidence intervals correspond to the differentials. We estimate the differentials across the two groups by estimating dynamic difference-in-differences specifications for their comparison, which include household fixed effects, time fixed effects, and a quadratic in the surviving spouse's age as controls.

Table 1: Mental Health Effects of Spousal Death by the Degree of Income Loss

	All	All	Males	Males	Females	Females
	(1)	(2)	(3)	(4)	(5)	(6)
Variable: Treat x Post x						
Household Income Loss	0.3304***	0.3087***	0.3527**	0.3555**	0.2994***	0.2588**
	(0.0837)	(0.0869)	(0.1425)	(0.1464)	(0.1041)	(0.1101)
Female	0.0067	0.0079				
	(0.0111)	(0.0114)				
Has Child Younger than 18	0.0058	0.0165	0.0074	0.0360	0.0044	0.0107
	(0.0229)	(0.0250)	(0.0391)	(0.0424)	(0.0284)	(0.0313)
Has Child Older than 18	-0.0009	-0.0032	-0.0032	-0.0163	-0.0054	-0.0028
	(0.0229)	(0.0235)	(0.0337)	(0.0349)	(0.0310)	(0.0318)
Log(Household Income)	0.0502***	0.0460***	0.0304	0.0345	0.0601***	0.0554***
	(0.0139)	(0.0157)	(0.0254)	(0.0281)	(0.0167)	(0.0193)
Additional Set of Controls		X		X		X
Number of Households	12,992	12,992	4,329	4,329	8,663	8,663
Mean Income Loss	0.387	0.387	0.358	0.358	0.400	0.400
Median Income Loss	0.402	0.402	0.378	0.378	0.410	0.410
Standard Deviation of Income Loss	0.171	0.171	0.171	0.171	0.169	0.169

Notes: This table reports two-stage least-squares estimates from the average difference-in-differences specification of equation (2), split by the gender of the surviving spouse. We instrument for the household's income loss with an indicator for whether the deceased spouse had earnings and a quadratic in the share of the household's income earned by the deceased spouse in the year before the event. All specifications include household fixed effects, calendar year fixed effects, and a quadratic in the surviving spouse's age, and are estimated using observations for years -1 and 0 relative to the event. The household's income loss is normalized at the mean of individuals in the treatment group and is winsorized at the top and bottom 1 percent. The additional set of controls include interactions of "Treat x Post" with the following characteristics of the surviving spouse at baseline: age and age squared, five geographic region dummies, seven education categories, an indicator for whether the surviving spouse had a psychiatric treatment, an indicator for whether the surviving spouse had a hospitalization, an indicator for the couple being married/cohabiting for ten years or more, and indicators for whether the couple was married or cohabiting. The reported statistics for income loss are calculated among households in the treatment group. Robust standard errors clustered at the household level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.