ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/376537015

Health and Cognitive Consequences of Widowhood in Middle-aged and Elderly in China

Article *in* SSRN Electronic Journal · January 2023

DOI: 10.2139/ssrn.4649231

CITATIONS
0

1 author:

Xinyuan Lyu
Duke University
3 PUBLICATIONS **0** CITATIONS

SEE PROFILE

All content following this page was uploaded by Xinyuan Lyu on 31 October 2024.

The user has requested enhancement of the downloaded file.

Health and Cognitive Consequences of Widowhood in Middle-aged and Elderly in China

Xinyuan Lyu

Abstract

This research utilizes China Health and Retirement Longitudinal Study (CHARLS) data employing event study methodology to investigate the effects of widowhood on mortality risk, health, and cognitive function among middle-aged and elderly individuals in China. I did not find significant effects of widowhood on mortality risk. However, my results indicate a minor impact on physical health, primarily reflected in an increased probability of chronic diseases. Notably, there is a significant rise in the risk of depression and cognitive impairment, adversely affecting Instrumental Activities of Daily Living (IADL) capabilities and life expectancy. Further, I observe considerable heterogeneity in the negative effects of widowhood across different genders, urban-rural categories, and city sizes. However, no significant differences were found across varying levels of education and the number of children, suggesting that children cannot substitute the role of a spouse in post-widowhood life. The mechanism analysis reveals that individuals try to mitigate the negative impacts of widowhood by significantly increasing social activities, leisure, and the use of more medical resources. Additionally, remarriage in middle and old age might offset the adverse effects of widowhood.

1.Introduction

All couples eventually face the inevitability of parting through death. In this sense, widowhood is an unavoidable event that will occur at some point. Since people may live a relatively long period after their spouse's death, studying the negative impacts of widowhood on middle-aged and elderly individuals is crucial for a deeper understanding of how to improve the quality of life in later years. In this study, I aim to explore the extent and types of the negative impacts that widowhood has on this demographic group.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

There has been a wealth of literature discussing the various consequences of widowhood in developed countries. These consequences first include an increased risk of death for the surviving spouse (J. Robin Moon et al., 2011; 2013; Gerard J. van den Berg et al., 2011). Additionally, extensive literature consistently shows that widowhood adversely affects the mental health and cognitive functions of the elderly (Debra Umberson et al., 1992; Margaret Stroebe et al., 2007; Kadir Atalay et al., 2020; Bettina Siflinger, 2017). Also, existing studies have long attempted to explain the mechanisms behind the detrimental health outcomes and increased mortality due to widowhood, such as lifestyle changes (Danit R. Shahar et al., 2001; Rebecca L. Utz et al., 2002), and reduced levels and efficiency of healthcare resource utilization (Emilia Simeonova, 2013).

Most of these studies have focused on the situation in developed countries, with few comprehensively considering the impact of widowhood in Chinese society. Only in the past three years have several high-quality studies using panel data from China analyzed the consequences of widowhood. Of particular relevance to my research are the works of Zhuo Chen et al. (2020) and Qin Li et al. (2023). The former used PSM+DID methods to study the impact of bereavement on mental health and quality of life among a sample of mid-aged and elderly adults, finding an increase in CESD scores but no significant effect on self-rated health; the latter, using dynamic DID methods, found that widowhood led to a decline in various physical and mental health indicators and cognitive functions, with the greatest impact on rural women.

Since widowhood may be associated with unobservable characteristics shared within the couples, direct regression inevitably has endogeneity issues. Therefore, a suitable solution is to use fixed effects to control for such characteristics, thereby studying the changes in health status due to widowhood. Meanwhile, although existing literature has adequately revealed the adverse consequences of widowhood, few studies have shown the long-term dynamic effects of widowhood, and it is difficult to assess whether individuals

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

were already affected or have anticipation effect prior to widowhood. Furthermore, if widowhood is significantly related to higher mortality risk, then the estimated results might suffer from sample selection bias, as the widowed individuals in the sample are those who survived, potentially underestimating the damage to health status due to widowhood. Given these issues, this paper will first examine whether widowhood leads to significant differences in mortality risk and then use event study methodology to comprehensively reveal the differences in individual conditions before and after widowhood relative to their counterfactual situations.

This study will use the China Health and Retirement Longitudinal Study (CHARLS) data from four waves of longitudinal surveys spanning eight years from 2011 to 2018 to form a panel. Given its detailed information, I can accurately identify the exact date of an individual's widowhood, which serves as the basis for our event study method. Additionally, given its comprehensive content, I can control for factors that may threaten identification and further analyze the rich heterogeneity and possible mechanisms.

Turning to the results, I found consistency with previous literature, showing that widowhood significantly harms mental health and cognitive functions. Using a dynamic model, I demonstrated the stability of the pretrend, indicating that the impact of widowhood on individuals is not anticipatory, thereby bolstering the confidence in the conclusions. Moreover, I showed that the impact of widowhood on the risk of depression is relatively short-term, while the damage to cognitive function and closely related IADL functions is long-term and persistent. This implies that the deterioration in quality of life due to widowhood may accompany individuals for a long time, severely impacting the late-life health welfare of the elderly. Through extensive robustness checks, I found that the main conclusions remain robust under various settings, particularly when using robust estimators for heterogeneous treatment effects.

Additional contributions of this paper is that through various heterogeneity analyses, I discovered that

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

widowhood particularly significantly and persistently affects individuals in socially disadvantaged positions. This is manifested in significantly higher and more enduring negative effects on female individuals, rural individuals, and those in areas with scarcer economic and medical resources. Additionally, I found that the number of children does not vary the effect of widowhood, suggesting that children cannot effectively substitute the role of a spouse and mitigate the negative impact of widowhood. Through mechanism analysis, I found that individuals indeed actively seek actions to mitigate the negative impact of widowhood after its occurrence, including more social activities and leisure pursuits, as well as more timely medical resource utilization under the same health conditions. Lastly, I revealed that remarriage in middle-aged and elderly people might be an effective way to resolve the negative impact of widowhood.

2.Data

The data of the research is from China Health and Retirement Longitudinal Study (CHARLS), which tracks around 17,000 individuals over the age of 45 across 150 county-level units and 450 village-level units nationwide, collecting comprehensive data on income, social interactions, economic status, health, medical care, and more. The survey utilizes stratified PPS sampling to ensure the representativeness of the sample while maintaining a high degree of estimation precision, covering urban and rural areas in 28 provinces across the country (Zhao et. al., 2013).

In this study, I utilized publicly available data from four waves conducted in 2011, 2013, 2015, and 2018. Due to variations in respondent participation across these waves and the addition of new respondents in each wave, I formed an unbalanced panel dataset, comprising a total of 80,916 observations. When constructing my research sample, I implemented the following data filtering process. Initially, I dropped observations with missing marital status information (951). Subsequently, I excluded observations of individuals below the age of 45 (2,591). After these two filtering steps, my final research sample consisted

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

of 77,374 observations, as shown in Table 1.

3.Variable Definition

3.1.Widowed

In each survey wave, respondents' marital status is reconfirmed, allowing us to determine whether they experienced widowhood during the respective wave. Additionally, if respondents were widowed, the questionnaire then includes inquiries about the timing and causes of their spouse's death. This information provides us with precise knowledge about the timing of widowhood for each respondent, enabling us to ascertain the distance since their bereavement at each interview.

Figure 1 illustrates the trend of widowhood with increasing age. It is evident that as age advances, the gender disparity in the proportion of widowed widens, with female consistently outnumbering male. This pattern aligns with the fact that women generally have a longer life expectancy compared to men[1]. Consequently, it implies that women typically endure longer periods of widowhood. Moreover, the graph reveals a significant increase in the probability of widowhood around the age range of 65-70, with the likelihood spiking sharply from less than 10% at age 60 to approximately 40% at age 80.

3.2.Outcome Variables

The outcome variables primarily consist of two sets of variables reflecting physical health and mental health with cognitive functioning. The variables used to gauge physical health include self-rated health, the presence of chronic diseases, difficulties in Activities of Daily Living (ADL), and difficulties in Instrumental Activities of Daily Living (IADL).

In each survey wave, respondents were asked to provide a subjective evaluation of their current health status. I consider "good" and "very good" responses as indicators of optimistic feelings or expectations

[1] Taking 2015 as a reference, the average age for females and males in China was 79.43 and 73.64, respectively (a difference of 5.79 years).

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

regarding their health. Additionally, respondents were classified as having a chronic disease if they had been diagnosed by a physician or had self-confirmed the presence of any one of 14 common chronic diseases, as specified in Appendix 1.

ADL and IADL are used to characterize basic and more complex daily self-care abilities (see Appendix 2). Basic ADL encompass activities such as eating, bathing, dressing, toileting, walking, mobility, and continence, while IADL encompass more complex and independent daily self-care abilities, such as shopping, cooking, using the telephone, managing medications, utilizing public transportation, and handling financial matters, among others (Sidney Katz et al., 1963). If the respondent has trouble in any of the abilities listed, I identify this respondent as "have trouble in ADL" or "have trouble in IADL".

On the front of mental health and cognitive functioning, I first considered the CESD (Center for Epidemiologic Studies Depression) score showed in Appendix 3, which is widely employed for a simple diagnosis of depression (Radloff, 1977). The CESD score ranges from 0 to 30, with higher scores indicating a greater tendency towards depression. A score of 16 or above is indicative of potential depressive symptoms.

Subsequently, I employed measurements of cognitive functioning consistent with prior literature in the field (Hu et al., 2012). Cognitive functioning was primarily characterized through a mental intactness score (ranging from 0 to 11) and episodic memory score (ranging from 0 to 10). The former encompasses abilities related to numerical calculations, time orientation, and picture drawing. The latter includes immediate word recall and delayed word recall. During the survey, respondents were required to complete a series of tasks and report the results. Data were recorded for the correctness of these tasks, and the final scores were computed based on individual task performance. Specific details and scoring procedures are provided in Appendix 4.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Finally, I incorporated a questionnaire item concerning life expectancy expectations to comprehensively assess respondents' self-evaluation of their health and their optimism regarding future life and longevity. For respondents in different age groups, the questionnaire inquired about the likelihood that they believed they would live to an age approximately 10-15 years into the future. If a respondent indicated that it was "almost impossible" or "not very likely", I categorized them as having a negative life expectancy, as detailed in Appendix 5.

Descriptive statistics of all the above variables are shown in Table 2 and descriptive statistics by years are shown in Appendix 7.

3.3.Controls and Channel Variables

Control variables encompass basic demographic characteristics, including gender, age, urban or rural, education level, as well as whether the respondent holds employee-based pension insurance[2]. Additionally, the number of children is also considered as part of the control variables. These control variables essentially portray the socioeconomic status and family circumstances of the respondents and will also serve as categorical variables in subsequent heterogeneity analyses.

Channel variables encompass whether the respondent consumes alcohol, is still employed, engages in social activities, and the respondent's healthcare resource utilization in the current year. Notably, social activities refer to any interaction with non-cohabitating individuals, including socializing with friends and participating in community activities (see Appendix 6). Healthcare resource utilization includes outpatient, high level outpatient, and inpatient these three variables. Outpatient signifies that the respondent received outpatient medical care within the past month. High level outpatient indicates receiving outpatient

[2] In China, there exists a substantial distinction between resident and employee-based pension insurance. Employee-based pension insurance is a formal retirement insurance scheme jointly contributed to by employers and employees, with government subsidies. Monthly benefits of Employee-based pension are generally significantly higher than those of resident-based pension insurance, which is funded by residents themselves, with government subsidies, and typically offers monthly benefits less than 100 Chinese Yuan.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

treatment at comprehensive hospitals, traditional Chinese medicine hospitals, or specialty hospitals within the past month, excluding lower-level healthcare institutions such as township health clinics. Inpatient denotes that the respondent underwent inpatient treatment within the past year.

4.The Effect of Widowhood on Mortality Risk

In this section, I will explore whether widowhood affects the mortality risk of the surviving spouse. Using balanced panel data starting from 2011, I designated individuals who were widowed in 2011 as the treatment group and those who were not as the control group. Subsequent waves showed significant mortality rate differences between these groups, as shown in Table 3. In the second wave, the mortality rate difference between the two groups was 0.073, 0.126 in the third wave, and as high as 0.194 in the fourth wave. However, this mortality rate difference is clearly confounded by age, as those who were widowed in the first wave were older therefore naturally had a higher risk of death. Therefore, the simple difference in mortality rates severely overestimates the impact of widowhood. So I conducted a regression analysis below.

I mainly adopted the logistic probability model, and the regression equation is as follows:

$$\frac{\Pr(Death=1)}{1-\Pr(Death=1)} = \exp(\beta_{widowed} Widowed_{cit} + \Gamma X_{cit} + \lambda_t + \alpha_c + \varepsilon_{cit})$$

Here, ***Pr(Death=1)*** represents the the probability of death for an individual ***i*** in community ***c*** at time ***t***. $Widowed_{cit}$ is a binary variable, assigned a value of 1 if the individual is widowed in the past waves and X_{cit} represents individual-level covariates; α_c denotes community fixed effects; and λ_t stands for year fixed effects. The content in the left hand side is the odds of death and e^{β} reflects the odds ratio for widowhood; a value greater than 1 (therefore β larger than 0) indicates an increase in mortality risk, while a value less than 1 indicates a decrease.

The results, as shown in Table 4, reveal that after controlling for necessary covariates, the odds ratio for

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

widowhood is only 1.046. This means that the widowed group's odds of death is only 4.6% higher than that of the non-widowed group, and this difference is not statistically significant, therefore, I conclude that widowhood does not lead to a significant increase in mortality risk. This finding is somewhat inconsistent with results from other countries (J. Robin Moon et al., 2011; Gerard J. van den Berg et al., 2011). However, this conclusion is a positively signal for my subsequent analysis. The lack of significant differences in mortality risk can partially alleviate my concerns about sample selection bias. If there were a significant difference in mortality risk between the widowed and non-bereaved groups, such as a significantly higher risk for the widowed, my estimates could potentially underestimate the health hazards of widowhood, which is because individuals more severely affected by widowhood might have died and therefore not entered the next wave of the sample.

5.The Effect of Widowhood on Health and Cognitive Function

5.1.Empirical Methods Setting

In this section I will adopt the empirical research methods of DID method and event study method. The setting of this method is as follows:

$$y_{it} = \beta \cdot Widowed_{it} + \Gamma X_{it} + \eta_t z_i + \alpha_i + \lambda_{ct} + \varepsilon_{it}$$

The left-hand side variable y_{it} represents the outcome variables. $Widowed_{it}$ is a binary variable, assigned a value of 1 if the individual is after the widowhood (this variable is always zero for the control group). Therefore, β is the main difference-in-differences coefficient to estimate. X_{it} represents individual-level covariates that change over time; α_i denotes individual fixed effects; and λ_{ct} stands for community-year fixed effects. However, if some predetermined covariates are correlated with the likelihood of experiencing a shock and also correlate with the time trend of the dependent variable such as gender and socio-economical status, this can lead to omitted variable bias. To address this potential bias, I introduce $\eta_t z_i$, which is the interaction term of predetermined individual characteristics and time.

In order to observe whether the prior trend is stable and to study the dynamic impact after the health shock, it is necessary to introduce the event study method:

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

$$y_{it} = \sum_{\substack{-T \\ \tau \neq -1}}^{T} \gamma_\tau \mathbf{1}(t - t^* = \tau) + \Gamma X_{it} + \eta_t z_i + \alpha_i + \lambda_{ct} + \varepsilon_{it}$$

The setup remains consistent with the standard difference-in-differences model, except that the broad categorization of being "post-treatment" is replaced with a series of dummy variables. ***1(t-t*=τ)*** indicates that individual ***i*** is in the ***τth*** period (each period for 2 years) after the widowhood at time ***t***, with ***τ*** taking a negative value to represent the period ***-τ*** before the shock. The benefits of this setup are twofold: First, it allows observation of pre-treatment trends and conducting tests on these trends. If pre-treatment trends are stable and their coefficients approach 0, it provides corroborative evidence and indirectly boosts the persuasiveness and confidence in the results' validity. Second, it provides insight into how post-treatment trends evolve, i.e., whether the effects of the shock persist or dissipate, or if families can recover quickly after a health shock.

5.2.Main Result

Table 5 and Figure 2 present the results of the aforementioned model estimations. All regressions are controlled for individual fixed effects and time fixed effects, with the latter capturing time effects at the community level. Additionally, I controlled for necessary time cross-terms involving predetermined covariates, including gender, age group level, education level, and whether has an employee pension.

In general, widowhood has a negative impact on physical health and functionality. However, its effects on self-rated health and Activities of Daily Living (ADL) functionality are not statistically significant. Simultaneously, widowhood has a highly significant impact on mental health and cognitive functionality. Specifically, widowhood increases the probability of having a chronic illness by 2.91 percentage points, which is approximately 6% of the mean. It also raises the probability of having difficulties with Instrumental Activities of Daily Living (IADL) by 3.66 percentage points, which is roughly 16% of the mean. The increase in the probability of IADL difficulties is associated with impairments in cognitive functionality. When individuals experience cognitive impairments or cognitive disorders, they may more likely to encounter difficulties in performing IADL tasks, which can pose challenges to their independent living. As seen in columns (6) and (7), widowhood leads to a decrease of 0.275 points in the mental intactness score and a decrease of 0.233 points in episodic memory, approximately 3.47% and 6.89% of the mean, respectively.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Lastly, widowhood has a significant and substantial negative impact on mental health, resulting in an increase of 1.302 points in the CESD score, approximately 16% of the mean. It also increases the probability of holding negative life expectations by 3.68 percentage points, roughly 11.6% of the mean.

The results of the event study indicate that all regressions essentially pass the pre-trend tests. Concerning the short-term and long-term effects of widowhood on middle-aged and elderly individuals, the impact on the CESD is mainly short-term, with increments of 1.418 and 0.524 in the 0th and 1st periods. However, from the 2nd period onwards, the influence gradually diminishes. Both the absolute size of the coefficients and the significance levels suggest a diminishing effect over time. In contrast, the probabilities of having difficulties in IADL and holding negative life expectancy continue to be affected, remaining nearly stable at the level observed in the 0th period. Meanwhile, the impact on mental intactness score and episodic memory even increases gradually. The decrease in the mental intactness score shifts from -0.267 in the 0th period to -0.626 in the 4th period, and the decrease in episodic memory score shifts from -0.189 to -0.436. This indicates that widowhood has a lasting and continuous impact on the cognitive function of middle-aged and elderly individuals. These findings are in line with the results of Li et al.'s (2023) study, which also identified significant short-term effects on CESD scores, sustained effects on ADL or IADL, and a progressively increasing long-term impact on episodic memory scores.

The impairment of IADL functionality, the elevation of depressive tendencies, and the sustained cognitive decline mutually exacerbate each other. According to existing literature, social interactions, feelings of loneliness, and psychological stress have been shown to be associated with cognitive function decline (Bennett DA et al., 2006; Wilson RS et al., 2007; Lupien SJ et al., 2009). Although the grief brought on by widowhood gradually diminishes, the feelings of loneliness and social isolation it brings are enduring. This explains why cognitive function decline persists. Additionally, the role of social interaction as a significant mediating factor will be further discussed in the subsequent sections.

5.3.Robustness Check

I subsequently conducted robustness tests on the basic results as shown in Table 6, which included changing cluster levels, adding more control variables, restricting the sample to a balanced panel, and considering the bias due to heterogeneous treatment effects of staggered DID.

First, I expanded the clustering level of robust standard errors from the community level to the city level to examine whether the significance level of the main conclusions is threatened. Next, I added more control

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

variables. In addition to the control variables included in the benchmark regression, in the regression of column (3), I also included interaction terms of individuals' continuous education years with time, hukou type and medical insurance type[3] with time. Additionally, column (4) shows the regression results using only a balanced panel, which excludes samples that did not respond in subsequent years and those that were added in later years. Comparing columns (1), (2), (3), and (4), I can see that the size and significance level of almost all estimated coefficients remain essentially consistent across different settings, attesting to the robustness of the main conclusions.

Meanwhile, The latest advancements in theoretical econometrics literature indicate that if groups receiving treatment at different time points exhibit heterogeneous treatment effects, meaning they follow different treatment effect trajectories, the estimates derived from the event-study methodology might still be severely biased even if the parallel trends and no anticipation assumptions are satisfied (Goodman-Bacon, 2021; Sun and Abraham, 2021; Borusyak et al., 2023; Dube et al., 2023).

In this study, the identified treatment effects are indeed likely to have heterogeneous treatment effects for different cohorts; for instance, the impact on the individuals experiencing a widowhood shock in 2010 might differ from experiencing it in 2015 due to the evolving macro social environment and their unobservable cohort-relative characters. Should such heterogeneity exist, it could lead to biased coefficients, necessitating the check using estimators robust to heterogeneous treatment effects. In column (5), I present estimates based on the cohort-time average treatment effect estimation method by Sun and Abraham, which artificially corrects for the problem of negative weights, thereby avoiding estimation bias. It can be seen that the robust estimator coefficients are still essentially consistent with those of the baseline regression. Furthermore, in Appendix 8 & 9, I show the event-study method based on Borusyak's imputation DID method, finding that the main conclusions still remain robust.

6.Heterogeneity and Mechanism Analysis

6.1.Empirical Methods Setting

I further need to explore whether there is heterogeneity in the effects of widowhood on individuals of different groups. Therefore, the following model is introduced:

[3] Medical insurance types roughly include employee and resident types, with the former being exclusive to urban employees and significantly superior to the latter.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

$$y_{it} = \beta \cdot Widowed_{it} \cdot H_i + \Gamma X_{it} + \eta_t z_i + \theta_t H_i + \alpha_i + \lambda_t + \varepsilon_{it}$$

$$y_{it} = \sum_{\substack{-T \\ \tau \neq -1}}^{T} \gamma_\tau \mathbf{1}(t - t^* = \tau) \cdot H_i + \Gamma X_{it} + \eta_t z_i + \theta_t H_i + \alpha_i + \lambda_t + \varepsilon_{it}$$

The setup is largely consistent with the basic DID and event study configuration above, except for the requirement to multiply the post-shock indicator variable with the group variable of interest, $\boldsymbol{H_i}$. Concurrently, this group variable is also multiplied with the time variable to avoid omitted variable bias.

6.2.Heterogeneity

The results of the heterogeneity analysis are presented in Table 7, and the heterogeneity in the dynamic model is shown in Appendix 10.

First, I examined whether the impact of widowhood has gender-specific effects. As shown in *Panel A*, I found that compared to men, women experience a larger increase in their CESD scores by 0.672 points following the shock of widowhood, nearly 1.6 times the coefficient for men. Additionally, their mental intactness score decreases more significantly, by -0.394 points, approximately six times the coefficient for men. This indicates that the reduction in mental intactness score is primarily driven by women. This finding contradicts Gary R. Lee et al. (2001), who observed a greater negative psychological impact of widowhood on men in the United States. However, it is consistent with findings of Li et al. (2023), which suggest that rural women are more profoundly affected by widowhood, both physically and mentally.

Interestingly, the dynamic trend, as illustrated in Appendix 10.1, shows a significant initial increase in CESD scores for men at period 0, while women's scores remain unchanged. However, men's coefficients drop to around zero from period 1 onwards, even turning negative from periods 3 and 4, whereas women only start showing a significant increase in scores from period 2, maintaining this significance subsequently. This suggests that, compared to men, the depressive risk brought on by widowhood may be more enduring and slow to manifest in women. This could be due to older men being more likely to gradually rely on external social networks for recovery from widowhood, while older women's social networks are often more closely tied to their families. Widowhood might permanently deprive them of this primary source of social support, resulting in a more persistent negative impact.

Secondly, I examined the heterogeneity between urban and rural areas as well as city size. The results are presented in *panel B and C*. Here, “city size” indicates the population scale of the city where an individual

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

resides, with larger numbers representing larger scales[4]. It is evident that both urban-rural heterogeneity and city size heterogeneity consistently show that rural and smaller city populations experience greater negative effects from widowhood, both in terms of physical and mental health as well as cognitive functions, yet are less likely to hold negative life expectancy expectations. Particularly noteworthy is the aspect of physical health: for each increase in city size category, the effect of widowhood on the likelihood of chronic diseases diminishes by 0.0165, and the probability of facing difficulties in Activities of Daily Living (ADL) reduces by 0.0271. This suggests that the inequality in urban-rural and regional development also manifests in unequal health impacts of widowhood. Urban residents and those in larger cities have greater access to quality healthcare and social resources, potentially offering them higher resilience against shocks. In contrast, groups in less advantaged positions are more likely to exhibit vulnerability when faced with such challenges.

Furthermore, I explored the heterogeneity in terms of age, educational level, and number of children, as detailed in *panels D-F*. It is observed that compared to the middle-aged group, the elderly group experiences less depression after the shock but suffers more significant cognitive impairment. Specifically, compared to the middle-aged group, the increase in CESD scores due to widowhood is 0.965 points less for the elderly, but the decrease in mental intactness and episodic memory scores are greater by 0.299 and 0.152 points, respectively. Moreover, as seen in Appendix 10.4, for the middle-aged group, the detrimental effects of widowhood on cognitive functions begin to emerge gradually after the fourth period, i.e., eight years later, indicating that the cognitive impairment due to widowhood has long-term effects. However, I did not find consistent significant heterogeneity in the effects of widowhood related to education level (indirectly representing socioeconomic status) or the number of children. This suggests that the support children can provide in the face of the shock of losing a spouse is relatively limited.

6.3.The Effect of Widowhood on Behaviors and Life Style

In this section, I further examined the impact of widowhood on lifestyle and behavior. Existing literature has demonstrated that social interactions and healthy behaviors are closely associated with the health and cognitive function of the elderly. Specifically, more social participation is linked to a lower risk of cognitive decline (Henriette Engelhardt et al., 2010; Srei Chanda et al., 2019; Xin Wang et al., 2023), and

[4] 1 represents a city population less than 500,000; 2 for populations between 500,000 and 1 million; 3 for 1 to 3 million; 4 for 3 to 5 million; and 5 for over 5 million. These five categories correspond to small cities, moderate cities, Type II large cities, Type I large cities, and mega-cities and above in China.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

alcohol consumption may also be related to cognitive function (Ruiyuan Zhang et al., 2020). Therefore, I first explored the effects of widowhood on alcohol consumption, social activities, and employment status, as shown in column (1)-(3) in Table 8 and Figure 3.

I observed that widowhood did not immediately increase the probability of alcohol consumption in the short term, but it began to have a noticeable effect from the second period, especially in the third period, with a coefficient of 0.0468, about 15% of the mean. Simultaneously, widowhood significantly increased the likelihood of engaging in social activities and reduced the probability of working. The former is natural, as the loneliness induced by widowhood compels individuals to seek social interactions outside the family, aligning with the conclusions of Rebecca L. Utz et al. (2002).

Furthermore, in Appendix 11, I presented the heterogeneity in the effects of widowhood caused by different lifestyles and health behaviors. I did not find significant heterogeneity in the effects of alcohol consumption on widowhood. Interestingly, engaging in social activities reduced the negative impacts of widowhood on health and cognitive functions. However, the group that continued to work experienced greater negative impacts from widowhood on all indicators. Considering the bias of reverse causality, the heterogeneity of continuing to work might even be underestimated. A possible explanation is that the necessity to continue working indirectly represents a socially and economically disadvantaged group. They often face greater difficulties after the shock of widowhood. Additionally, for individuals engaged in agricultural or domestic production, the death of a spouse means the loss of family labor, potentially leading to additional work pressure and thus harming their health.

In Appendix 12, I demonstrated the correlations between variables such as gender and urban-rural status with lifestyle and behavior variables. It was observed that women, compared to men, indeed have a lower probability of participating in social activities, which corresponds with my analysis in the previous section.

6.4.The Effect of Widowhood on Medical Utilization

The loss of a caregiver and companion due to widowhood may hinder an individual's travel in daily life. A natural assumption is that the absence of caregivers and companions may lead to a decrease in the use of medical resources, thereby mediating a deterioration in health status. Indeed, some studies have shown that widowhood leads to a reduction and decreased effectiveness in health care utilization (Emilia Simeonova, 2013).

In columns (4)-(6) of Table 8 and in Figure 3, I present the impact of widowhood on the use of various

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

medical resources. It is observed that widowhood increased the probability of using outpatient services in the past month by 3.13 percentage points (about 16% of the mean) and increased the probability of using inpatient services in the past year by 5.70 percentage points (about 42% of the mean). Considering that this rise in medical resource use might be due to deteriorating health caused by widowhood itself, I further controlled for various health indicators and re-ran regressions on medical resource use in columns (6)-(8). However, even after controlling for health status, the coefficient for the increase in inpatient utilization due to widowhood remained at 0.0441. This implies that widowhood does not decrease but rather increases the probability of using medical resources.

This conclusion is inconsistent with the hypothesis mentioned above but exactly aligns with the findings of Fadlon et al. (2019), who discovered that severe health shocks to a family member can serve as a warning to improve the health behaviors of other family members. Meanwhile, this result also partially explains why the physical health is less impacted by widowhood. Integrating the results of the previous section, I can conclude that individuals, following widowhood, may try to mitigate the negative impacts through various means and behaviors, including increased social activities and more extensive use of medical resources. However, the direct detrimental effects of widowhood remain significant.

6.5.Can Remarriage Mitigate the Negative Impacts of Widowhood?

Finally, I sought to examine whether remarriage in middle-aged and elderly individuals, following the experience of widowhood, can offset the negative impacts of losing a spouse. The presence of a new partner through remarriage was hypothesized to potentially mitigate these adverse effects. But unfortunately, due to the extremely limited sample size of individuals who have remarried (less than 100 people), my estimates could not be sufficiently accurate. The results of my regression analysis are presented in Table 9.

From the data, it is evident that for widowed individuals, remarriage aligns completely with my hypothesis in terms of direction regardless of significant level. That is, remarriage appears to improve all health and cognitive function indicators. This is particularly notable in the CESD score, mental intactness score, episodic memory score, and holding a negative life expectancy. In these areas, remarriage can almost halve the negative effects brought about by widowhood.

7.Conclusions

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

This study examines the impact of widowhood on mortality risk, health indicators, and cognitive function among middle-aged and elderly individuals in contemporary China. The findings indicate that widowhood does not significantly affect individual mortality risk and has a minimal impact on physical health. However, widowhood significantly increases the short-term risk of depression and persistently impairs cognitive functions and Instrumental Activities of Daily Living (IADL) abilities in both short and long terms. Furthermore, widowhood continuously lead to a larger possibility of having negative life expectancy. These conclusions remain valid across different model settings and robustness checks.

Further heterogeneity analysis reveals that compared to men, women experience more substantial and enduring adverse effects from widowhood. Urban residents, particularly those from larger cities, are less affected by the negative impacts of widowhood, indicating a disparity based on urban-rural differences and regional economic development. And interestingly, no significant heterogeneity is found in the impact of widowhood based on the number of children, suggesting that children's support is relatively limited in mitigating the effects of spousal loss and children cannot effectively substitute the role of a spouse. Mechanism analysis shows that individuals seek to mitigate the negative impacts of widowhood through increased social activities and leisure (decreased work probability), and higher likelihood of using medical resources. Additionally, remarriage appears to effectively counteract the adverse effects of widowhood, particularly in psychological health and cognitive functions.

References

Andrew Goodman-Bacon. Difference-in-differences with variation in treatment timing, *Journal of Econometrics*. Volume 225, Issue 2, 2021, ISSN 0304-4076.

Bennett DA, Schneider JA, Tang Y, Arnold SE, Wilson RS. The effect of social networks on the relation between Alzheimer's disease pathology and level of cognitive function in old people: a longitudinal cohort study. *The Lancet Neurology*. 2006 May 1;5(5):406-12.

Borusyak K., Jaravel X., Spiess J. 2023, Revisiting Event Study Designs, Robust and Efficient Estimation [R].Working Paper.

Bettina Siflinger. The Effect of Widowhood on Mental Health - An Analysis of Anticipation Patterns Surrounding The Death of A Spouse. *Health Econ*. 26: 1505–1523 (2017).

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Chen, Z., Ying, J., Ingles, J. et al. Gender differential impact of bereavement on health outcomes: evidence from the China Health and Retirement Longitudinal Study, 2011–2015. *BMC Psychiatry* 20, 514 (2020).

Danit R. Shahar, Richard Schultz, Avner Shahar, Rena R. Wing. The Effect of Widowhood on Weight Change, Dietary Intake, and Eating Behavior in the Elderly Population. *JOURNAL OF AGING AND HEALTH*, Vol. 13 No. 2, May 2001, 186-199.

Dube A., Girardi D., Jordà Òscar., Taylor A.M., A Local Projections Approach to Difference-in-Differences Event Studies [R] 2023. Working Paper.

Debra Umberson, Camille B. Wortman and Ronald C. Kessler. Widowhood and Depression: Explaining Long-Term Gender Differences in Vulnerability. *Journal of Health and Social Behavior*, Vol. 33, No. 1 (Mar., 1992), pp. 10-24.

Emilia Simeonova. Marriage, bereavement and mortality: The role of health care utilization. *Journal of Health Economics* 32 (2013) 33–50.

Gerard J. van den Berga, Maarten Lindeboomb, France Portrait. Conjugal bereavement effects on health and mortality at advanced ages. *Journal of Health Economics* 30 (2011) 774–794.

Gary R. Lee, Alfred DeMaris, Stefoni Bavin, and Rachel Sullivan. Gender Differences in the Depressive Effect of Widowhood in Later Life. *Journal of Gerontology: SOCIAL SCIENCES*, 2001, Vol. 56B, No. 1, S56–S61.

Henriette Engelhardt , Isabella Buber , Vegard Skirbekk, Alexia Prskawetz. Social involvement, behavioural risks and cognitive functioning among the aged. *Ageing & Society* 30, 2010, 000-000.

Itzik Fadlon and Torben Heien Nielsen. 2019a. "Family Health Behaviors." *American Economic Review* 109 (9): 3162–91.

J. Robin Moon, Naoki Kondo, M. Maria Glymour, S. V. Subramanian. Widowhood and Mortality: A Meta-Analysis. (2011) PLoS ONE 6(8): e23465.

Kadir Atalaya, Anita Stanevab. The effect of bereavement on cognitive functioning among elderly people: Evidence from Australia. *Economics and Human Biology* 39 (2020) 100932.

Lenore Sawyer Radloff. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population, Applied Psychological Measurement. Vol.1 No.3 Summer 1997, pp385-401.

Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of stress throughout the lifespan on the brain, behavimy and cognition. *Nature reviews neuroscience*, 2009 Jun;10(6):434-45.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Liyang Sun, Sarah Abraham. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, Volume 225, Issue 2, 2021, Pages 175-199, ISSN 0304-4076.

Margaret Stroebe, Henk Schut, Wolfgang Stroebe. Health outcomes of bereavement. *Lancet* 2007; 370: 1960–73.

Qin Li , James P. Smith , Yaohui Zhao. Understanding the effects of widowhood on health in China: Mechanisms and heterogeneity. *The Journal of the Economics of Ageing*, 25 (2023) 100458

Ruiyuan Zhang, Luqi Shen, Toni Miles. Association of Low to Moderate Alcohol Drinking With Cognitive Functions From Middle to Older Age Among US Adults. *JAMA Netw Open*. 2020;3(6):e207922.

Rebecca L. Utz, Deborah Carr, Randolph Nesse, Camille B. Wortman. The Effect of Widowhood on Older Adults'Social Participation: An Evaluation of Activity, Disengagement, and Continuity Theories. *The Gerontologist*. Vol. 42, No. 4, 522–533.

Sidney Katz, MD, Amasa B. Ford, MD, Roland W. Moskowitz, MD, Beverly A. Jackson, BS, and Marjorie W. Jaffe, MA, Cleveland. Studies of Illness in the Aged The Index of ADL: A Standardized Measure of Biological and Psychosocial Function. *JAMA*, September 21, 1963.

Srei Chanda, Raman Mishra. Impact of transition in work status and social participation on cognitive performance among elderly in India. *BMC Geriatrics* (2019) 19:251.

Wilson RS, Krueger KR, Arnold SE, Schneider JA, Kelly JF, Barnes LL, Tang Y, Bennett DA. Loneliness and risk of Alzheimer disease, *Archives of general psychiatry*. 2007 Feb 1;64(2):234-40.

XinWang, Kelly M. Bakulski, Henry L. Paulson, Roger L.Albin, Sung Kyun Park. Associations of healthy lifestyle and socioeconomic status with cognitive function in U.S. older adults. *Scientifc Reports* (2023) 13:7513.

Yaohui Zhao,J Strauss et. al. China Health And Retirement Longitudinal Study – 2011-2012 National Baseline Users' Guide, 2013.

Yuqing Hu, Xiaoyan Lei, James P. Smith, and Yaohui Zhao. Effects of Social Activities on Cognitive Functions: Evidence from CHARLS, National Research Council. 2012. *Aging in Asia: Findings from New and Emerging Data Initiatives*. Washington, DC: The National Academies Press.

Zhuo Chen, Jiahui Ying, Justin Ingles, Donglan Zhang, Janani Rajbhandari-Thapa, Ruoxi Wang, Kerstin Gerst Emerson and Zhanchun Feng. Gender differential impact of bereavement on health outcomes: evidence from the China Health and Retirement Longitudinal Study, 2011–2015. *BMC Psychiatry* (2020) 20:514.

Preprint not peer reviewed

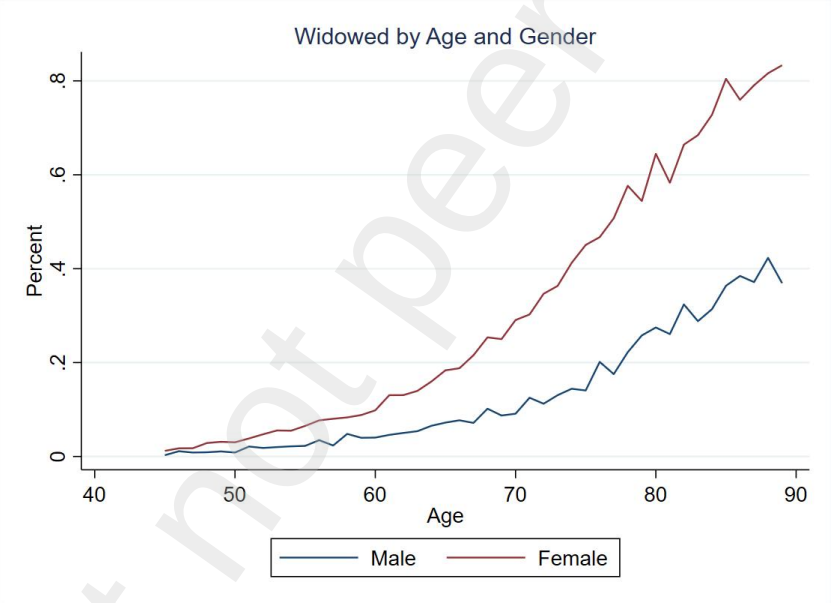
This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Tables and Figures

Table 1. Sample Generation Process

Drop	Description	Keep
		80916
951	Drop if miss whether widowed	79965
2,591	Drop if Age blow 45 or miss Age	77374

Figure 1. Percentage of Widowed by Age and Gender



Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 2. Descriptive Statistics

Variable Name	Mean	SD	Min	Max	Observations
Dependent Variables					
Self-rated Health Good or Very Good	0.2414	0.4279	0	1	70129
Have Any Chronic	0.4893	0.4999	0	1	73540
Have Trouble in ADL	0.1869	0.3898	0	1	71268
Have Trouble in IADL	0.2285	0.4198	0	1	71324
CESD Score	8.1357	6.2643	0	30	62016
Mental Intactness Score	7.9195	2.6878	0	11	51589
Episodic Memory Score	3.3816	1.8660	0	10	63473
Negative Life Expectancy	0.3171	0.4654	0	1	57335
Independent Variables and Controls					
Widowed	0.1239	0.3295	0	1	77374
Female	0.5107	0.4999	0	1	77374
Age	60.8384	10.5310	45	118	77374
Urban	0.4006	0.4900	0	1	77358
Senior High or above	0.1238	0.3294	0	1	73919
Have Employee Pension	0.1368	0.3436	0	1	73237
Children Numbers	2.7796	1.6075	0	14	77374
Chanel Variables					
Drink	0.2639	0.4407	0	1	73358
Still Working	0.6576	0.4745	0	1	73272
Have Social Activities	0.5285	0.4992	0	1	67897
Outpatient	0.1941	0.3955	0	1	69752
High Level Outpatient	0.0813	0.2733	0	1	69720
Inpatient	0.1344	0.3411	0	1	69889
Remarriage	0.0032	0.0569	0	1	73887

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 3. Death Ratio Comparison: Balanced Panel Since 2011

	Widowed in Wave 1			Control			All		
Wave	alive	dead	dead/all	alive	dead	dead/all	alive	dead	dead/all
1	1,378	0	**0.000**	11,239	0	**0.000**	12,617	0	**0.000**
2	1,244	134	**0.097**	10,965	274	**0.024**	12,209	408	**0.032**
3	1,128	250	**0.181**	10,625	614	**0.055**	11,753	864	**0.068**
4	975	403	**0.292**	10,138	1,101	**0.098**	11,113	1,504	**0.119**

Table 4. Effect of Widowhood on Mortality

	(1)		(2)		(3)		(4)	
Death	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Widowed	**1.294*** **	**3.646*** **	**1.455*** **	**4.284*** **	**0.0719**	**1.075**	**0.0454**	**1.046**
	(0.0657)	(0.240)	(0.0689)	(0.295)	(0.0765)	(0.0822)	(0.0765)	(0.0800)
Female			-0.624***	0.536***	-0.514***	0.598***	-0.535***	0.585***
			(0.0541)	(0.0290)	(0.0577)	(0.0345)	(0.0639)	(0.0374)
Age					0.0334	1.034	0.0494	1.051
					(0.0291)	(0.0301)	(0.0306)	(0.0322)
Age^2					0.0595**	1.061**	0.0504**	1.052**
					(0.0208)	(0.0221)	(0.0219)	(0.0230)
Employee insurance							-0.655***	0.519***
							(0.130)	(0.0674)
Agricultural hukou							0.437***	1.547***
							(0.106)	(0.164)
Schooling							0.0102	1.010
							(0.00904)	(0.00913)
Community FEs	Yes		Yes		Yes		Yes	
Year FEs	Yes		Yes		Yes		Yes	
Observations	58,342		58,342		58,342		57,221	

Note: *1. In parentheses is the robust standard error of clustering at community level. 2.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 5. DID and Event Study Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
Mean	**0.2414**	**0.4893**	**0.1869**	**0.2285**	**8.1357**	**7.9195**	**3.3816**	**0.3171**
Panel A: DID Estimator								
Widowed	**-0.0150**	**0.0291****	**0.00833**	**0.0366*****	**1.302*****	**-0.275*****	**-0.233*****	**0.0368****
	(0.0122)	(0.0124)	(0.0124)	(0.0129)	(0.206)	(0.0898)	(0.0552)	(0.0164)
Constant	0.237***	0.481***	0.189***	0.227***	8.040***	8.083***	3.406***	0.320***
	(0.00141)	(0.00150)	(0.00152)	(0.00159)	(0.0215)	(0.00839)	(0.00594)	(0.00175)
Panel B: Event Study								
Pre 3	**0.00820**	**-0.0181**	**0.00670**	**0.00272**	**-0.448**	**-0.0921**	**0.00260**	**0.00255**
	(0.0194)	(0.0232)	(0.0222)	(0.0220)	(0.293)	(0.158)	(0.0825)	(0.0264)
Pre 2	**-0.00467**	**-0.00793**	**0.00929**	**-0.000619**	**-0.306**	**0.0178**	**0.0428**	**0.0180**
	(0.0181)	(0.0181)	(0.0166)	(0.0179)	(0.229)	(0.119)	(0.0639)	(0.0222)
Post 0	**-0.0101**	**0.0212**	**0.0227**	**0.0468*****	**1.418*****	**-0.267****	**-0.189*****	**0.0401****
	(0.0150)	(0.0157)	(0.0150)	(0.0160)	(0.242)	(0.109)	(0.0649)	(0.0192)
Post 1	**-0.0128**	**0.0137**	**-0.00881**	**0.0403****	**0.524***	**-0.317****	**-0.256*****	**0.0491****
	(0.0194)	(0.0191)	(0.0201)	(0.0190)	(0.304)	(0.142)	(0.0793)	(0.0230)
Post 2	**0.00396**	**0.0253**	**-0.0118**	**0.0369**	**0.285**	**-0.212**	**-0.440*****	**0.0419**
	(0.0234)	(0.0227)	(0.0244)	(0.0242)	(0.395)	(0.161)	(0.100)	(0.0322)
Post 3	**0.0149**	**0.0161**	**-0.0151**	**0.0282**	**-0.620**	**-0.555****	**-0.357*****	**0.0488**
	(0.0286)	(0.0284)	(0.0296)	(0.0285)	(0.444)	(0.216)	(0.119)	(0.0365)
Post 4	**0.0139**	**-0.0133**	**0.0103**	**0.0358**	**-0.156**	**-0.626****	**-0.436*****	**0.0401**
	(0.0333)	(0.0319)	(0.0348)	(0.0363)	(0.527)	(0.244)	(0.144)	(0.0430)
Constant	0.235***	0.483***	0.189***	0.227***	8.156***	8.100***	3.420***	0.318***
	(0.00258)	(0.00275)	(0.00291)	(0.00292)	(0.0374)	(0.0150)	(0.0105)	(0.00316)
Observations	65,585	69,260	67,085	67,147	57,076	45,189	58,790	51,678
Number of individuals	19523	20253	19872	19884	18036	15195	18323	16972
R-squared	0.550	0.599	0.686	0.572	0.564	0.689	0.667	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Figure 2. Event Study

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 6. Robustness Check

	(1)	(2)	(3)	(4)	(5)
Specification	[Baseline]	Cluster on City	Add More Controls	Balanced Panel	Robust Estimator
			Panel A: Self-rated health GVG		
DID estimator	**-0.0168**	**-0.0168**	**-0.0167**	**-0.0145**	**-0.0155**
	(0.0136)	(0.0135)	(0.0136)	(0.0147)	(0.0137)
Effect within 4 years	**-0.0171**	**-0.0171**	**-0.0171**	**-0.0146**	**-0.0155**
	(0.0136)	(0.0137)	(0.0137)	(0.0147)	(0.0138)
Effect in 4-8 years	**0.000991**	**0.000991**	**0.00113**	**0.00500**	**0.00184**
	(0.0205)	(0.0217)	(0.0206)	(0.0219)	(0.0208)
Effect after 8 years	**0.00675**	**0.00675**	**0.00628**	**0.0118**	**0.00276**
	(0.0292)	(0.0300)	(0.0292)	(0.0315)	(0.0291)
Observations	65,585	65,585	64,745	48,715	63,488
			Panel B: Have any chronic		
DID estimator	**0.0292****	**0.0292****	**0.0307****	**0.0348****	**0.0292****
	(0.0129)	(0.0135)	(0.0129)	(0.0140)	(0.0131)
Effect within 4 years	**0.0275****	**0.0275****	**0.0290****	**0.0336****	**0.0279****
	(0.0129)	(0.0135)	(0.0130)	(0.0140)	(0.0131)
Effect in 4-8 years	**0.0327**	**0.0327**	**0.0345***	**0.0412***	**0.0329**
	(0.0208)	(0.0223)	(0.0209)	(0.0216)	(0.0212)
Effect after 8 years	**-0.000950**	**-0.000950**	**0.000985**	**0.00700**	**-0.00158**
	(0.0288)	(0.0305)	(0.0288)	(0.0298)	(0.0291)
Observations	69,260	69,260	68,359	50,765	66,993
			Panel C: Have trouble in ADL		
DID estimator	**0.0125**	**0.0125**	**0.0126**	**0.00932**	**0.0127**
	(0.0135)	(0.0138)	(0.0135)	(0.0150)	(0.0137)
Effect within 4 years	**0.0141**	**0.0141**	**0.0143**	**0.00976**	**0.0139**
	(0.0135)	(0.0138)	(0.0135)	(0.0150)	(0.0137)
Effect in 4-8 years	**0.00442**	**0.00442**	**0.00470**	**-0.00669**	**0.00395**
	(0.0224)	(0.0221)	(0.0224)	(0.0251)	(0.0226)
Effect after 8 years	**0.0319**	**0.0319**	**0.0320**	**0.0106**	**0.0328**
	(0.0301)	(0.0309)	(0.0300)	(0.0329)	(0.0304)
Observations	67,085	67,085	66,372	49,745	65,057
			Panel D: Have trouble in IADL		
DID estimator	**0.0424*****	**0.0424*****	**0.0426*****	**0.0320****	**0.0434*****
	(0.0137)	(0.0133)	(0.0137)	(0.0154)	(0.0138)
Effect within 4 years	**0.0437*****	**0.0437*****	**0.0438*****	**0.0326****	**0.0437*****
	(0.0138)	(0.0135)	(0.0138)	(0.0154)	(0.0139)
Effect in 4-8 years	**0.0377***	**0.0377**	**0.0377***	**0.0265**	**0.0380***
	(0.0227)	(0.0249)	(0.0228)	(0.0251)	(0.0230)
Effect after 8 years	**0.0447**	**0.0447**	**0.0455**	**0.0440**	**0.0448**
	(0.0325)	(0.0375)	(0.0325)	(0.0350)	(0.0330)

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Observations	67,147	67,147	66,426	49,779	65,107
			Panel E: CESD Score		
DID estimator	**1.535*** **	**1.535*** **	**1.561*** **	**1.627*** **	**1.506*** **
	(0.220)	(0.232)	(0.219)	(0.239)	(0.222)
Effect within 4 years	**1.547*** **	**1.547*** **	**1.573*** **	**1.646*** **	**1.515*** **
	(0.219)	(0.231)	(0.218)	(0.239)	(0.222)
Effect in 4-8 years	**0.807** **	**0.807** **	**0.840** **	**1.114*** **	**0.750** **
	(0.354)	(0.390)	(0.353)	(0.389)	(0.357)
Effect after 8 years	**1.051** **	**1.051** **	**1.107** **	**1.598*** **	**0.984** **
	(0.473)	(0.497)	(0.472)	(0.522)	(0.477)
Observations	57,076	57,076	56,336	42,736	55,232
			Panel F: Mental Intactness Score		
DID estimator	**-0.318*** **	**-0.318*** **	**-0.329*** **	**-0.337*** **	**-0.329*** **
	(0.0936)	(0.0894)	(0.0931)	(0.101)	(0.0953)
Effect within 4 years	**-0.324*** **	**-0.324*** **	**-0.333*** **	**-0.345*** **	**-0.335*** **
	(0.0937)	(0.0892)	(0.0933)	(0.101)	(0.0952)
Effect in 4-8 years	**-0.305** **	**-0.305** **	**-0.313** **	**-0.396*** **	**-0.328** **
	(0.148)	(0.152)	(0.147)	(0.153)	(0.150)
Effect after 8 years	**-0.478** **	**-0.478** **	**-0.487** **	**-0.623*** **	**-0.500** **
	(0.213)	(0.217)	(0.212)	(0.227)	(0.216)
Observations	45,189	45,189	44,570	33,602	43,730
			Panel G: Episodic Memory Score		
DID estimator	**-0.192*** **	**-0.192*** **	**-0.197*** **	**-0.195*** **	**-0.196*** **
	(0.0586)	(0.0644)	(0.0588)	(0.0624)	(0.0596)
Effect within 4 years	**-0.196*** **	**-0.196*** **	**-0.202*** **	**-0.198*** **	**-0.197*** **
	(0.0590)	(0.0640)	(0.0591)	(0.0629)	(0.0599)
Effect in 4-8 years	**-0.380*** **	**-0.380*** **	**-0.382*** **	**-0.402*** **	**-0.379*** **
	(0.0918)	(0.0961)	(0.0921)	(0.0991)	(0.0929)
Effect after 8 years	**-0.415*** **	**-0.415*** **	**-0.416*** **	**-0.515*** **	**-0.415*** **
	(0.131)	(0.132)	(0.131)	(0.144)	(0.133)
Observations	58,790	58,790	57,998	43,949	56,945
			Panel H: Negative Life Expectancy		
DID estimator	**0.0368** **	**0.0368** **	**0.0378** **	**0.0371** **	**0.0339** **
	(0.0164)	(0.0158)	(0.0164)	(0.0174)	(0.0167)
Effect within 4 years	**0.0362** **	**0.0362** **	**0.0375** **	**0.0377** **	**0.0337** **
	(0.0165)	(0.0159)	(0.0164)	(0.0174)	(0.0167)
Effect in 4-8 years	**0.0340**	**0.0340**	**0.0353**	**0.0379**	**0.0313**
	(0.0293)	(0.0316)	(0.0293)	(0.0322)	(0.0297)
Effect after 8 years	**0.0270**	**0.0270**	**0.0292**	**0.0633**	**0.0313**
	(0.0398)	(0.0444)	(0.0398)	(0.0430)	(0.0297)
Observations	51,402	51,402	50,801	39,183	50,034

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6. p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 7. Heterogeneity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
Mean	**0.2414**	**0.4893**	**0.1869**	**0.2285**	**8.1357**	**7.9195**	**3.3816**	**0.3171**
				Panel A: Female vs. Male				
Female*Widowed	**-0.00891**	**-0.00650**	**-0.000862**	**0.0149**	**0.672***	**-0.394****	**-0.133**	**-0.0374**
	(0.0264)	(0.0274)	(0.0264)	(0.0298)	(0.405)	(0.182)	(0.118)	(0.0353)
Widowed	**-0.0113**	**0.0332**	**0.0136**	**0.0334**	**1.095*****	**-0.0757**	**-0.106**	**0.0605****
	(0.0227)	(0.0231)	(0.0215)	(0.0243)	(0.328)	(0.151)	(0.0949)	(0.0269)
				Panel B: Urban vs. Rural				
Urban*Widowed	**0.0104**	**-0.00696**	**-0.0442**	**-0.0248**	**-0.134**	**0.106**	**0.243****	**0.0706****
	(0.0282)	(0.0270)	(0.0270)	(0.0278)	(0.457)	(0.193)	(0.118)	(0.0349)
Widowed	**-0.0210**	**0.0312****	**0.0283***	**0.0520*****	**1.586*****	**-0.363*****	**-0.284*****	**0.0117**
	(0.0170)	(0.0154)	(0.0171)	(0.0169)	(0.275)	(0.119)	(0.0737)	(0.0198)
				Panel C: Small City vs. Large City				
City Size*Widowed	**0.0114**	**-0.0165**	**-0.0271****	**-0.0124**	**-0.270**	**0.0365**	**-0.0763**	**0.00883**
	(0.0150)	(0.0130)	(0.0131)	(0.0144)	(0.186)	(0.0912)	(0.0561)	(0.0166)
Widowed	**-0.0454**	**0.0724****	**0.0836****	**0.0759***	**2.216*****	**-0.428**	**0.00553**	**0.0111**
	(0.0417)	(0.0364)	(0.0370)	(0.0401)	(0.529)	(0.261)	(0.162)	(0.0452)
				Panel D: Middle Aged vs. Elderly				
Elderly*Widowed	**0.0178**	**0.000139**	**-0.0110**	**0.0225**	**-0.965*****	**-0.299****	**-0.152****	**0.00749**
	(0.0172)	(0.0169)	(0.0174)	(0.0175)	(0.277)	(0.129)	(0.0706)	(0.0203)
Widowed	**-0.0284***	**0.0287***	**0.0201**	**0.0288***	**2.103*****	**-0.134**	**-0.101**	**0.0317**
	(0.0172)	(0.0159)	(0.0162)	(0.0173)	(0.289)	(0.119)	(0.0720)	(0.0200)
				Panel E: Education Senior High and Above vs. Below				
High*Widowed	**0.0230**	**-0.0323**	**-0.0378**	**-0.00163**	**0.320**	**-0.179**	**0.195**	**-0.00966**
	(0.0408)	(0.0412)	(0.0362)	(0.0397)	(0.614)	(0.246)	(0.196)	(0.0596)
Widowed	**-0.0188**	**0.0310****	**0.0156**	**0.0435*****	**1.513*****	**-0.300*****	**-0.209*****	**0.0372****
	(0.0136)	(0.0134)	(0.0142)	(0.0144)	(0.228)	(0.0964)	(0.0593)	(0.0168)
				Panel F: Have Two or More Children vs. Less Than Two				
More*Widowed	**0.0282**	**0.0569**	**-0.0596**	**-0.0144**	**-0.649**	**-0.0496**	**-0.0986**	**-0.0290**
	(0.0425)	(0.0406)	(0.0389)	(0.0430)	(0.768)	(0.322)	(0.198)	(0.0437)
Widowed	**-0.0428**	**-0.0229**	**0.0674***	**0.0563**	**2.122*****	**-0.273**	**-0.105**	**0.0627**
	(0.0419)	(0.0389)	(0.0365)	(0.0391)	(0.751)	(0.306)	(0.195)	(0.0397)
Observations	65,585	69,260	67,085	67,147	57,076	45,189	58,790	51,678
Number of Individuals	19523	20253	19872	19884	18036	15195	18323	16972
R-squared	0.550	0.599	0.686	0.572	0.564	0.689	0.667	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6. p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 8. Mechanism analysis

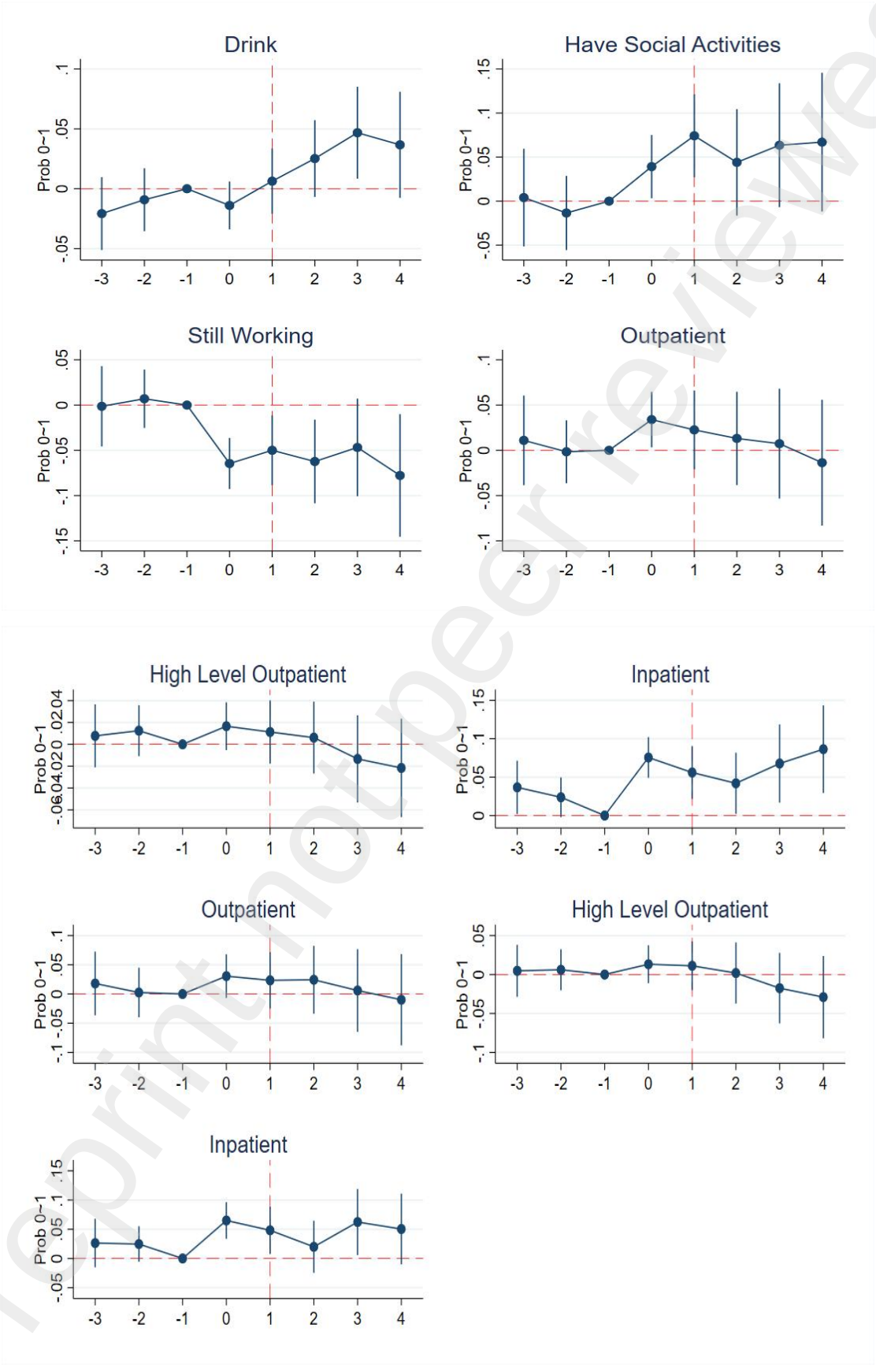
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Drink	Have Social Activities	Still Working	Outpatient	High Level Outpatient	Inpatient	Outpatient With Control	High Level Outpatient With Control	Inpatient With Control
Mean	**0.2639**	**0.6576**	**0.5285**	**0.1941**	**0.0813**	**0.1344**	**0.1941**	**0.0813**	**0.1344**
				Panel A: DID Estimator					
DID	**-0.00429**	**0.0504*** **	**-0.0625*** **	**0.0313** **	**0.0116**	**0.0570*** **	**0.0254**	**0.0107**	**0.0441*** **
	(0.00934)	(0.0155)	(0.0128)	(0.0138)	(0.00946)	(0.0123)	(0.0158)	(0.0101)	(0.0140)
Constant	0.258***	0.520***	0.667***	0.192***	0.0782***	0.126***	0.175***	0.0686***	0.109***
	(0.00111)	(0.00180)	(0.00152)	(0.00168)	(0.00115)	(0.00149)	(0.00175)	(0.00112)	(0.00155)
				Panel B: Dynamic Specification					
Pre 3	**-0.0207**	**0.00400**	**-0.00135**	**0.0110**	**0.00775**	**0.0367** **	**0.0180**	**0.00475**	**0.0263**
	(0.0155)	(0.0283)	(0.0226)	(0.0253)	(0.0147)	(0.0177)	(0.0278)	(0.0170)	(0.0212)
Pre 2	**-0.00918**	**-0.0135**	**0.00699**	**-0.00158**	**0.0125**	**0.0238** *	**0.00256**	**0.00610**	**0.0247**
	(0.0134)	(0.0215)	(0.0165)	(0.0177)	(0.0119)	(0.0132)	(0.0217)	(0.0135)	(0.0155)
Post 0	**-0.0139**	**0.0391** **	**-0.0645*** **	**0.0340** **	**0.0166**	**0.0756*** **	**0.0306**	**0.0132**	**0.0650*** **
	(0.0102)	(0.0183)	(0.0144)	(0.0156)	(0.0112)	(0.0135)	(0.0190)	(0.0125)	(0.0160)
Post 1	**0.00635**	**0.0742*** **	**-0.0499** **	**0.0226**	**0.0113**	**0.0560*** **	**0.0234**	**0.0112**	**0.0482** **
	(0.0139)	(0.0240)	(0.0197)	(0.0222)	(0.0148)	(0.0176)	(0.0246)	(0.0159)	(0.0205)
Post 2	**0.0252**	**0.0440**	**-0.0623*** **	**0.0132**	**0.00614**	**0.0420** **	**0.0243**	**0.00193**	**0.0200**
	(0.0163)	(0.0308)	(0.0236)	(0.0263)	(0.0168)	(0.0203)	(0.0296)	(0.0200)	(0.0227)
Post 3	**0.0468** **	**0.0635** *	**-0.0468** *	**0.00739**	**-0.0134**	**0.0677*** **	**0.00595**	**-0.0175**	**0.0624** **
	(0.0196)	(0.0359)	(0.0275)	(0.0310)	(0.0204)	(0.0260)	(0.0361)	(0.0231)	(0.0289)
Post 4	**0.0367**	**0.0670** *	**-0.0777** **	**-0.0136**	**-0.0216**	**0.0864*** **	**-0.00986**	**-0.0290**	**0.0504**
	(0.0226)	(0.0402)	(0.0345)	(0.0354)	(0.0230)	(0.0290)	(0.0398)	(0.0269)	(0.0309)
Constant	0.255***	0.519***	0.667***	0.195***	0.0802***	0.124***	0.177***	0.0708***	0.108***
	(0.00194)	(0.00335)	(0.00280)	(0.00305)	(0.00203)	(0.00244)	(0.00316)	(0.00213)	(0.00238)
Observations	68,698	62,876	68,796	65,426	65,392	65,581	47,117	47,101	47,221
Number of individuals	20042	18876	20056	18818	18814	18844	16185	16183	16217
R-squared	0.751	0.541	0.702	0.420	0.391	0.435	0.482	0.459	0.491

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Figure 3. Mechanism analysis



Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Table 9. Mechanism analysis: Remarriage

VARIABLES	(1) Self-rated Health Good or Very Good	(2) Have Any Chronic	(3) Have Trouble in ADL	(4) Have Trouble in IADL	(5) CESD Score	(6) Mental Intactness Score	(7) Episodic Memory Score	(8) Negative Life Expectancy
Mean	**0.2414**	**0.4893**	**0.1869**	**0.2285**	**8.1357**	**7.9195**	**3.3816**	**0.3171**
Marry again	**0.0346**	**-0.0156**	**-0.0309**	**-0.00713**	**-0.754**	**0.0364**	**0.102**	**-0.0274**
	(0.0331)	(0.0358)	(0.0348)	(0.0342)	(0.579)	(0.248)	(0.130)	(0.0477)
Widowed	**-0.0177**	**0.0290****	**0.0134**	**0.0434*****	**1.547*****	**-0.318*****	**-0.196*****	**0.0368****
	(0.0136)	(0.0129)	(0.0135)	(0.0137)	(0.220)	(0.0939)	(0.0588)	(0.0164)
Constant	0.238***	0.480***	0.188***	0.226***	8.010***	8.090***	3.406***	0.319***
	(0.00154)	(0.00152)	(0.00162)	(0.00165)	(0.0225)	(0.00857)	(0.00620)	(0.00176)
Observations	65,172	68,771	66,613	66,672	56,759	44,942	58,466	51,401
R-squared	0.550	0.598	0.572	0.563	0.685	0.689	0.667	0.654
Number of Individuals	19354	20054	19678	19688	17901	15086	18183	16856

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix

Appnedix 1. Chronic List

1. Hypertension
2. Dyslipidemia (elevation of low density lipoprotein, triglycerides (TGs), and total cholesterol, or a low high density lipoprotein level)
3. Diabetes or high blood sugar
4. Cancer or malignant tumor (excluding minor skin cancers)
5. Chronic lung diseases, such as chronic bronchitis , emphysema (excluding tumors, or cancer)
6. Liver disease (except fatty liver, tumors, and cancer)
7. Heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems
8. Stroke
9. Kidney disease (except for tumor or cancer)
10. Stomach or other digestive disease (except for tumor or cancer)
11. Emotional, nervous, or psychiatric problems
12. Memory-related disease
13. Arthritis or rheumatism
14. Asthma

Appendix 2. ADL/IADL Scale

ADL
Do you have trouble dressing yourself for health and memory reasons? Getting dressed involves taking clothes out of the closet, putting them on, buttoning them up, and putting on a belt.
Do you have trouble bathing for health and memory reasons?
Do you have trouble eating by yourself, such as helping yourself, for health and memory reasons?
Do you have any trouble getting up and out of bed?
Do you have trouble going to the toilet, including squatting and standing up, for health and memory reasons?
Do you have trouble controlling your bowel movements due to health and memory problems?
IADL
Do you have trouble doing housework because of health and memory?
Do you have trouble cooking because of health and memory?
Do you have trouble getting to the store to buy groceries on your own because of health and memory? When we say buy something, we mean decide what to buy and pay for it.
Do you have trouble managing money, such as paying bills, keeping track of expenses, and managing your belongings, for health and memory reasons?
Do you have trouble taking medicine on your own for health and memory reasons? Taking medicine means being able to remember when and how much to eat.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 3. CESD Scale

I am bothered by trivial matters.
I find it hard to concentrate when doing things.
I feel low in spirits.
I feel that doing anything is a great effort.
I am full of hope for the future.
I feel scared.
My sleep is not good.
I am cheerful.
I feel lonely.
I feel that I cannot continue with my life.

Note: The options for each question are as follows:
Rarely or not at all (<1 day)
Not too much (1-2 days)
Sometimes or about half the time (3-4 days)
Most of the time (5-7 days)

For the 8 negative questions, the scores for the options are 0, 1, 2, 3 points respectively; for the 2 positive questions, the scores are 3, 2, 1, 0 points respectively. The total score ranges from 0 to 30 points. The higher the score, the greater the risk of depression, and the worse the assessment of mental health condition.

Appendix 4. Cognitive Function Scale

Types	Items	Survey Questions	Score
Mental intactness (0–11)	Numerical ability	What does 100 minus 7 equal? And 7 from that?..	0~5
	Time orientation	Please tell me today's date (year, month, day).	0~3
		Please tell me the day of the week.	0~1
		What is the current season (among Spring, Summer, Fall, or Winter)?	0~1
	Picture drawing	Do you see this picture? Please draw that picture on this paper.	0~1
Episodic memory (0–10)	Immediate word recall	Try to remember the words I just read to you. I'll ask you to recall them later.	0~10
	Delayed word recall	A little while ago, I read you a list of words and you repeated the ones you could remember. Please tell me any of the words that you remember now.	0~10

Note: The episodic memory score is the average of immediate word recall score and delayed word recall score.

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 5. Life Expectancy

INTERVIEWER CHECK AGE OF RESPONDENT? 访员请检查受访者的年龄。	**1.** < 65 **YEAR 岁 →COLUMN A A 栏** **2.** 65 – 69 **YEAR 岁 →COLUMN B B 栏** **3.** 70 – 74 **YEAR 岁 →COLUMN C C 栏** **4.** 75 – 79 **YEAR 岁 →COLUMN D D 栏** **5.** 80 – 84 **YEAR 岁 →COLUMN E E 栏**				**6.** 85 – 89 **YEAR 岁 →COLUMN F F 栏** **7.** 90 – 94 **YEAR 岁 →COLUMN G G 栏** **8.** 95 – 99 **YEAR 岁 →COLUMN H H 栏** **9.** ≥ 100 **YEAR 岁 →COLUMN I I 栏**				
	A	B	C	D	E	F	G	H	I
AGE 年龄	75 years 岁	80 years 岁	85 years 岁	90 years 岁	95 years 岁	100 years 岁	105 years 岁	110 years 岁	115 years 岁
DA081 Suppose there are 5 steps, where the lowest step represents the smallest chance and the highest step represents the highest chance, on what step do you think is your chance in reaching the age of [...]? 假定有五个级别，最低一级代表可能性最小，最高一级代表可能性最大，您设想您活到这个年龄的可能性有多大。1 Almost impossible 几乎不可能 2 Not very likely 不太可能 3 Maybe 有可能 4 Very likely 很可能 5 Almost certain 简直一定	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Note: From CHARLS 2015.

Appendix 6. Social Activities

Have you done any of these activities in the last month? (Code all that apply):

(1) Interacted with friends

(2) Played Ma-jong, played chess, played cards, or went to community club

(3) Provided help to family, friends, or neighbors who do not live with you and who did not pay you for the help

(4) Went to a sport, social, or other kind of club

(5) Took part in a community-related organization

(6) Done voluntary or charity work

(7) Cared for a sick or disabled adult who does not live with you and who did not pay you for the help

(8) Attended an educational or training course

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 7. Descriptive Statistics By Years

Waves	2011		2013		2015		2018	
Variable Name	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dependent Variables								
Self-rated Health Good or Very Good	**0.2326**	0.4225	**0.2352**	0.4241	**0.2482**	0.4320	**0.2487**	0.4323
Have Any Chronic	**0.6755**	0.4682	**0.7063**	0.4555	**0.7000**	0.4583	**0.7942**	0.4043
Have Trouble in ADL	**0.1700**	0.3757	**0.1826**	0.3863	**0.2066**	0.4048	**0.1865**	0.3895
Have Trouble in IADL	**0.2195**	0.4139	**0.2182**	0.4130	**0.2339**	0.4233	**0.2404**	0.4273
CESD Score	**8.4175**	6.3539	**7.8286**	5.7784	**7.9010**	6.3817	**8.4170**	6.4746
Mental Intactness Score	**8.0470**	2.6997	**8.6879**	2.3222	**8.1453**	2.5201	**7.1206**	2.8414
Episodic Memory Score	**3.5006**	1.7550	**3.6810**	1.6904	**3.2398**	1.9052	**3.1520**	2.0230
Negative Life Expectancy	**0.2892**	0.4534	**0.3143**	0.4642	**0.3344**	0.4718	**0.3274**	0.4693
Independent Variables and Controls								
Widowed	**0.1132**	0.3169	**0.1186**	0.3233	**0.1214**	0.3266	**0.1394**	0.3464
Female	**0.5110**	0.4999	**0.5138**	0.4998	**0.5078**	0.5000	**0.5105**	0.4999
Age	**59.0374**	9.8568	**60.1929**	10.1569	**60.8060**	10.5684	**62.8787**	10.9909
Urban	**0.4036**	0.4906	**0.4019**	0.4903	**0.4003**	0.4900	**0.3971**	0.4893
Senior High or above	**0.1278**	0.3339	**0.1312**	0.3376	**0.1108**	0.3139	**0.1266**	0.3325
Have Employee Pension	**0.0450**	0.2074	**0.1655**	0.3717	**0.1321**	0.3386	**0.1955**	0.3966
Children Numbers	**2.8196**	1.6869	**2.8621**	1.5888	**2.7720**	1.5672	**2.6832**	1.5917
Chanel Variables								
Drink	**0.2538**	0.4352	**0.2669**	0.4423	**0.2695**	0.4437	**0.2642**	0.4409
Still Working	**0.6719**	0.4695	**0.6673**	0.4712	**0.6601**	0.4737	**0.6336**	0.4818
Have Social Activities	**0.4913**	0.4999	**0.5742**	0.4945	**0.5394**	0.4985	**0.5090**	0.4999
Outpatient	**0.1940**	0.3955	**0.2179**	0.4128	**0.2032**	0.4024	**0.1647**	0.3709
High Level Outpatient	**0.0677**	0.2513	**0.0892**	0.2851	**0.0858**	0.2801	**0.0821**	0.2746
Inpatient	**0.0921**	0.2891	**0.1323**	0.3388	**0.1416**	0.3487	**0.1678**	0.3737
Remarriage	**0.0052**	0.0720	**0.0015**	0.0393	**0.0031**	0.0558	**0.0032**	0.0567

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 8. Imputation DID (Table)

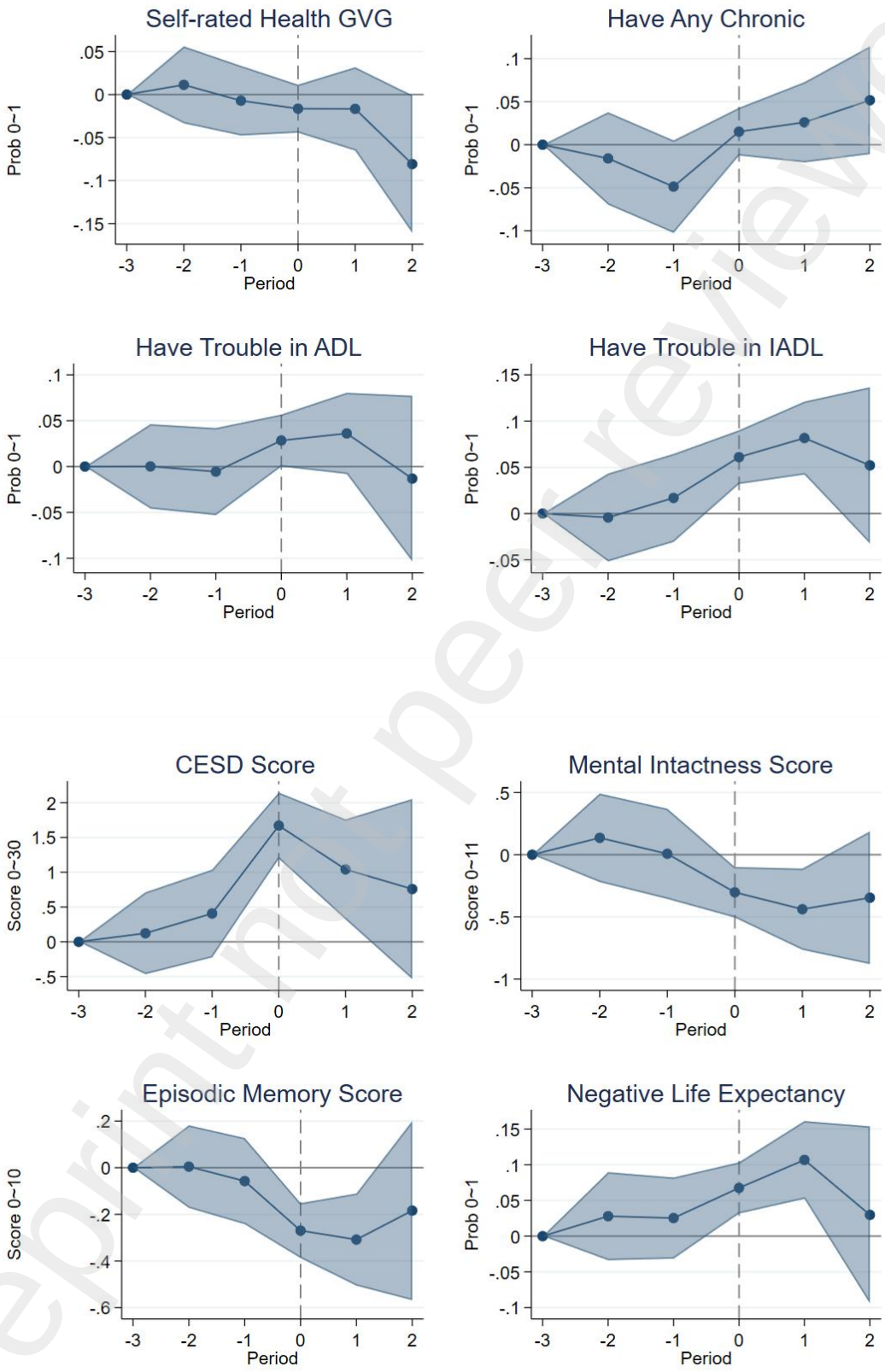
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
Mean	**0.2414**	**0.4893**	**0.1869**	**0.2285**	**8.1357**	**7.9195**	**3.3816**	**0.3171**
				Event Study: Borusyak DID Imputation				
Pre 2	**0.0113**	**-0.0159**	**0.000173**	**-0.00422**	**0.122**	**0.136**	**0.00474**	**0.0280**
	(0.0229)	(0.0274)	(0.0235)	(0.0242)	(0.301)	(0.182)	(0.0904)	(0.0315)
Pre 1	**-0.00711**	**-0.0487***	**-0.00553**	**0.0169**	**0.406**	**0.00729**	**-0.0573**	**0.0253**
	(0.0207)	(0.0274)	(0.0242)	(0.0243)	(0.322)	(0.185)	(0.0943)	(0.0290)
Post 0	**-0.0164**	**0.0152**	**0.0284****	**0.0610*****	**1.671*****	**-0.302*****	**-0.270*****	**0.0675*****
	(0.0142)	(0.0141)	(0.0145)	(0.0148)	(0.243)	(0.104)	(0.0602)	(0.0183)
Post 1	**-0.0166**	**0.0261**	**0.0361**	**0.0817*****	**1.041*****	**-0.438*****	**-0.308*****	**0.107*****
	(0.0247)	(0.0238)	(0.0226)	(0.0201)	(0.367)	(0.166)	(0.101)	(0.0278)
Post 2	**-0.0808****	**0.0517**	**-0.0131**	**0.0521**	**0.759**	**-0.346**	**-0.184**	**0.0298**
	(0.0408)	(0.0319)	(0.0461)	(0.0431)	(0.661)	(0.272)	(0.196)	(0.0632)
Observations	69,321	72,695	70,432	70,486	61,285	50,884	62,687	56,626

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01. 7.The regression use did_imputation introduced by Borusyak.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 9. Imputation DID (Figure)



Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10. Heterogeneity

Appendix 10.1. Heterogeneity: Gender

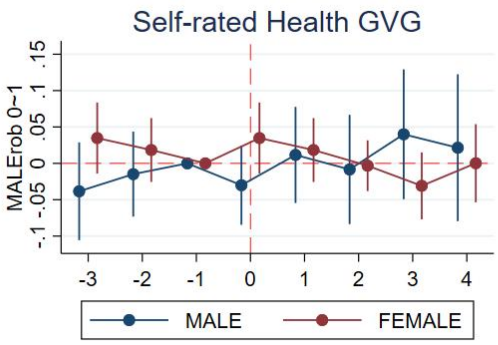
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
				Panel A: DID Estimator				
Female*Widowed	**-0.00891**	**-0.00650**	**-0.000862**	**0.0149**	**0.672***	**-0.394****	**-0.133**	**-0.0324**
	(0.0264)	(0.0274)	(0.0264)	(0.0298)	(0.405)	(0.182)	(0.118)	(0.0354)
Widowed	**-0.0113**	**0.0332**	**0.0136**	**0.0334**	**1.095*****	**-0.0757**	**-0.106**	**0.0548****
	(0.0227)	(0.0231)	(0.0215)	(0.0243)	(0.328)	(0.151)	(0.0949)	(0.0270)
				Panel B: Dynamic Specification				
Interaction: Female	**-0.0105**	**-0.00402**	**0.000923**	**0.0162**	**0.629**	**-0.409****	**-0.129**	**-0.0320**
	(0.0266)	(0.0276)	(0.0264)	(0.0299)	(0.404)	(0.182)	(0.118)	(0.0354)
Effect within 4 years	**-0.0101**	**0.0301**	**0.0134**	**0.0327**	**1.134*****	**-0.0721**	**-0.110**	**0.0544****
	(0.0228)	(0.0232)	(0.0215)	(0.0242)	(0.327)	(0.151)	(0.0952)	(0.0271)
Interaction: Female	**0.0107**	**-0.0477**	**-0.0167**	**-0.0177**	**1.786*****	**-0.160**	**-0.141**	**-0.0390**
	(0.0391)	(0.0442)	(0.0423)	(0.0461)	(0.638)	(0.312)	(0.179)	(0.0577)
Effect in 4-8 years	**-0.00700**	**0.0667***	**0.0163**	**0.0512**	**-0.424**	**-0.216**	**-0.286***	**0.0571**
	(0.0344)	(0.0397)	(0.0356)	(0.0389)	(0.560)	(0.251)	(0.153)	(0.0461)
Interaction: Female	**0.0224**	**-0.0385**	**-0.0249**	**0.0280**	**1.484**	**-0.408**	**-0.522****	**-0.0463**
	(0.0544)	(0.0555)	(0.0571)	(0.0577)	(0.915)	(0.495)	(0.250)	(0.0727)
Effect after 8 years	**-0.0102**	**0.0259**	**0.0501**	**0.0232**	**0.0456**	**-0.218**	**-0.0377**	**0.0562**
	(0.0492)	(0.0490)	(0.0488)	(0.0525)	(0.841)	(0.413)	(0.227)	(0.0601)
Observations	65,173	68,772	66,614	66,673	56,760	44,943	58,468	50,027
Number of Individuals	19354	20054	19678	19688	17901	15086	18184	16438
R-squared	0.550	0.598	0.572	0.563	0.685	0.689	0.667	0.654

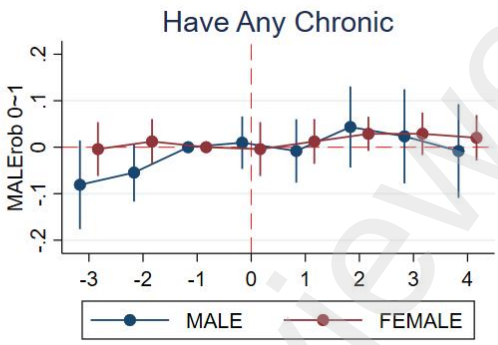
Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

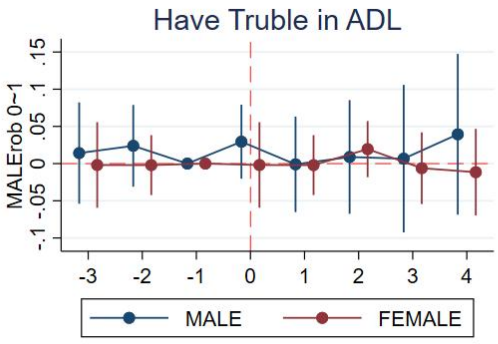
Preprint not peer reviewed

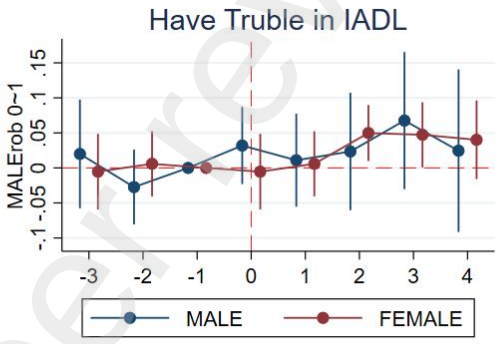
This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

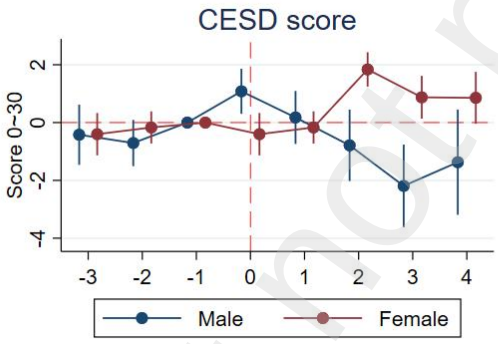
Appendix 10.1. Heterogeneity: Gender

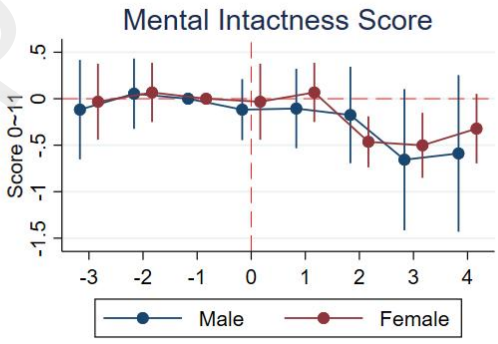


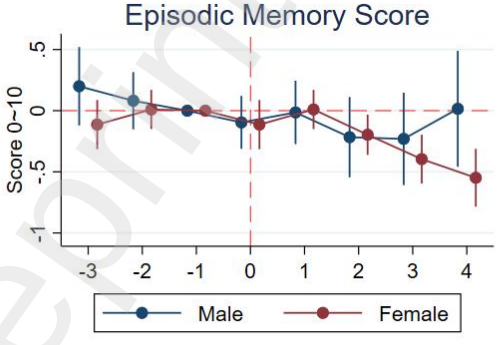


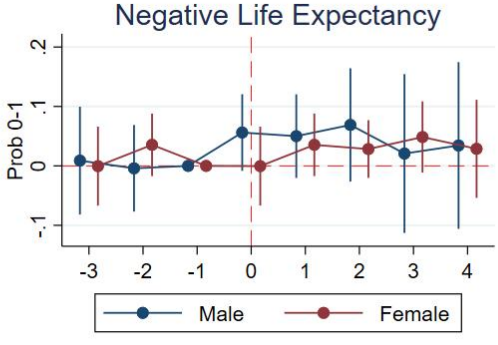












Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10.2. Heterogeneity: Urban or Rural

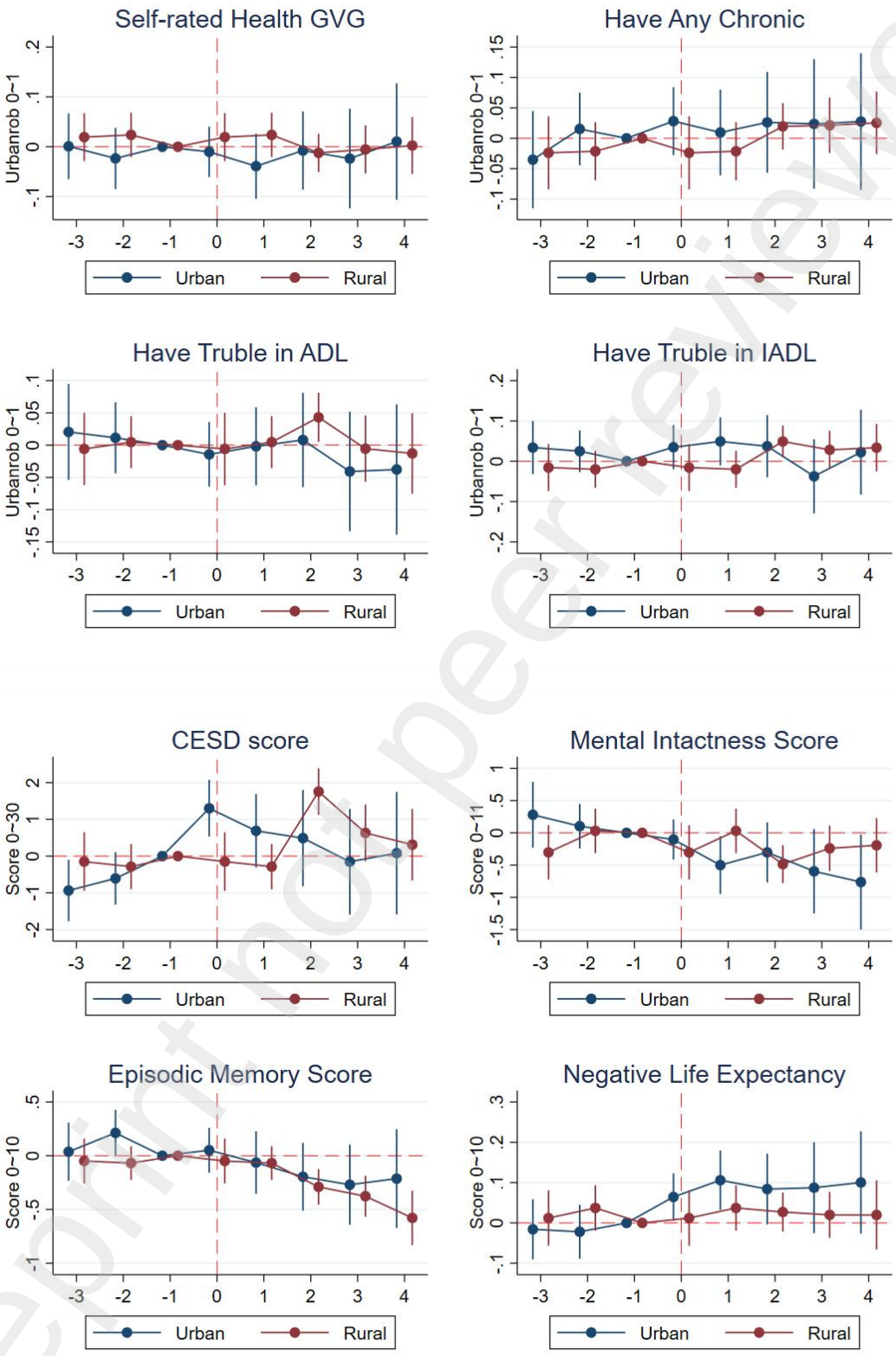
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
				Panel A: DID Estimator				
Urban*Widowed	**0.0104**	**-0.00696**	**-0.0442**	**-0.0248**	**-0.134**	**0.106**	**0.243****	**0.0706****
	(0.0282)	(0.0270)	(0.0270)	(0.0278)	(0.457)	(0.193)	(0.118)	(0.0349)
Widowed	**-0.0210**	**0.0312****	**0.0283***	**0.0520*****	**1.586*****	**-0.363*****	**-0.284*****	**0.0117**
	(0.0170)	(0.0154)	(0.0171)	(0.0169)	(0.275)	(0.119)	(0.0737)	(0.0198)
				Panel B: Dynamic Specification				
Interaction: Urban	**0.0110**	**-0.00587**	**-0.0459***	**-0.0231**	**-0.140**	**0.105**	**0.247****	**0.0715****
	(0.0282)	(0.0270)	(0.0270)	(0.0279)	(0.455)	(0.193)	(0.118)	(0.0350)
Effect within 4 years	**-0.0211**	**0.0296***	**0.0300***	**0.0517*****	**1.598*****	**-0.368*****	**-0.287*****	**0.0112**
	(0.0171)	(0.0154)	(0.0171)	(0.0170)	(0.274)	(0.119)	(0.0739)	(0.0198)
Interaction: Urban	**0.0124**	**0.00231**	**-0.0263**	**-0.0510**	**0.146**	**0.0986**	**0.267**	**0.0602**
	(0.0430)	(0.0441)	(0.0440)	(0.0454)	(0.745)	(0.294)	(0.176)	(0.0570)
Effect in 4-8 years	**-0.00339**	**0.0319**	**0.0133**	**0.0557****	**0.757***	**-0.346***	**-0.480*****	**0.0130**
	(0.0254)	(0.0238)	(0.0282)	(0.0278)	(0.433)	(0.202)	(0.120)	(0.0395)
Interaction: Urban	**0.0517**	**0.0604**	**-0.0855**	**0.000484**	**-0.127**	**0.000889**	**0.393**	**0.0909**
	(0.0626)	(0.0587)	(0.0571)	(0.0616)	(0.967)	(0.422)	(0.255)	(0.0764)
Effect after 8 years	**-0.0121**	**-0.0230**	**0.0626**	**0.0438**	**1.107***	**-0.478***	**-0.564*****	**-0.00515**
	(0.0343)	(0.0331)	(0.0384)	(0.0413)	(0.611)	(0.284)	(0.160)	(0.0529)
Observations	65,173	68,772	66,614	66,673	56,760	44,943	58,468	51,402
Number of Individuals	19354	20054	19678	19688	17901	15086	18184	16856
R-squared	0.550	0.598	0.572	0.563	0.685	0.689	0.667	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10.2. Heterogeneity: Urban or Rural



Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10.3. Heterogeneity: Small City vs. Large City

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
				Panel A: DID Estimator				
City Size*Widowed	**0.0114**	**-0.0165**	**-0.0271****	**-0.0124**	**-0.270**	**0.0365**	**-0.0763**	**0.00883**
	(0.0150)	(0.0130)	(0.0131)	(0.0144)	(0.186)	(0.0912)	(0.0561)	(0.0166)
Widowed	**-0.0454**	**0.0724****	**0.0836****	**0.0759***	**2.216*****	**-0.428**	**0.00553**	**0.0111**
	(0.0417)	(0.0364)	(0.0370)	(0.0401)	(0.529)	(0.261)	(0.162)	(0.0452)
				Panel B: Dynamic Specification				
Interaction: City Size	**0.0108**	**-0.0158**	**-0.0272****	**-0.0119**	**-0.270**	**0.0401**	**-0.0726**	**0.0102**
	(0.0150)	(0.0130)	(0.0130)	(0.0144)	(0.185)	(0.0911)	(0.0561)	(0.0167)
Effect within 4 years	**-0.0436**	**0.0693***	**0.0849****	**0.0747***	**2.225*****	**-0.443***	**-0.00607**	**0.00714**
	(0.0418)	(0.0364)	(0.0369)	(0.0400)	(0.523)	(0.262)	(0.162)	(0.0454)
Interaction: City Size	**0.0390***	**-0.0173**	**-0.0310**	**-0.00578**	**-0.608****	**0.0338**	**-0.199****	**-0.0212**
	(0.0232)	(0.0212)	(0.0239)	(0.0243)	(0.308)	(0.140)	(0.0831)	(0.0270)
Effect in 4-8 years	**-0.101**	**0.0780**	**0.0850**	**0.0531**	**2.351****	**-0.420**	**0.148**	**0.0878**
	(0.0631)	(0.0591)	(0.0659)	(0.0705)	(0.917)	(0.405)	(0.249)	(0.0757)
Interaction: City Size	**0.0453**	**0.0112**	**-0.0376**	**0.0308**	**-0.899****	**0.202**	**-0.123**	**-0.00446**
	(0.0318)	(0.0285)	(0.0309)	(0.0350)	(0.422)	(0.203)	(0.124)	(0.0388)
Effect after 8 years	**-0.116**	**-0.0306**	**0.131**	**-0.0353**	**3.357*****	**-1.047***	**-0.0934**	**0.0377**
	(0.0864)	(0.0744)	(0.0861)	(0.0971)	(1.265)	(0.629)	(0.371)	(0.108)
Observations	63,484	66,990	65,054	65,104	55,226	43,722	56,936	50,027
Number of Individuals	18884	19566	19243	19250	17456	14696	17741	16438
R-squared	0.552	0.600	0.573	0.565	0.687	0.688	0.666	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10.4. Heterogeneity: Middle Aged vs. Elderly

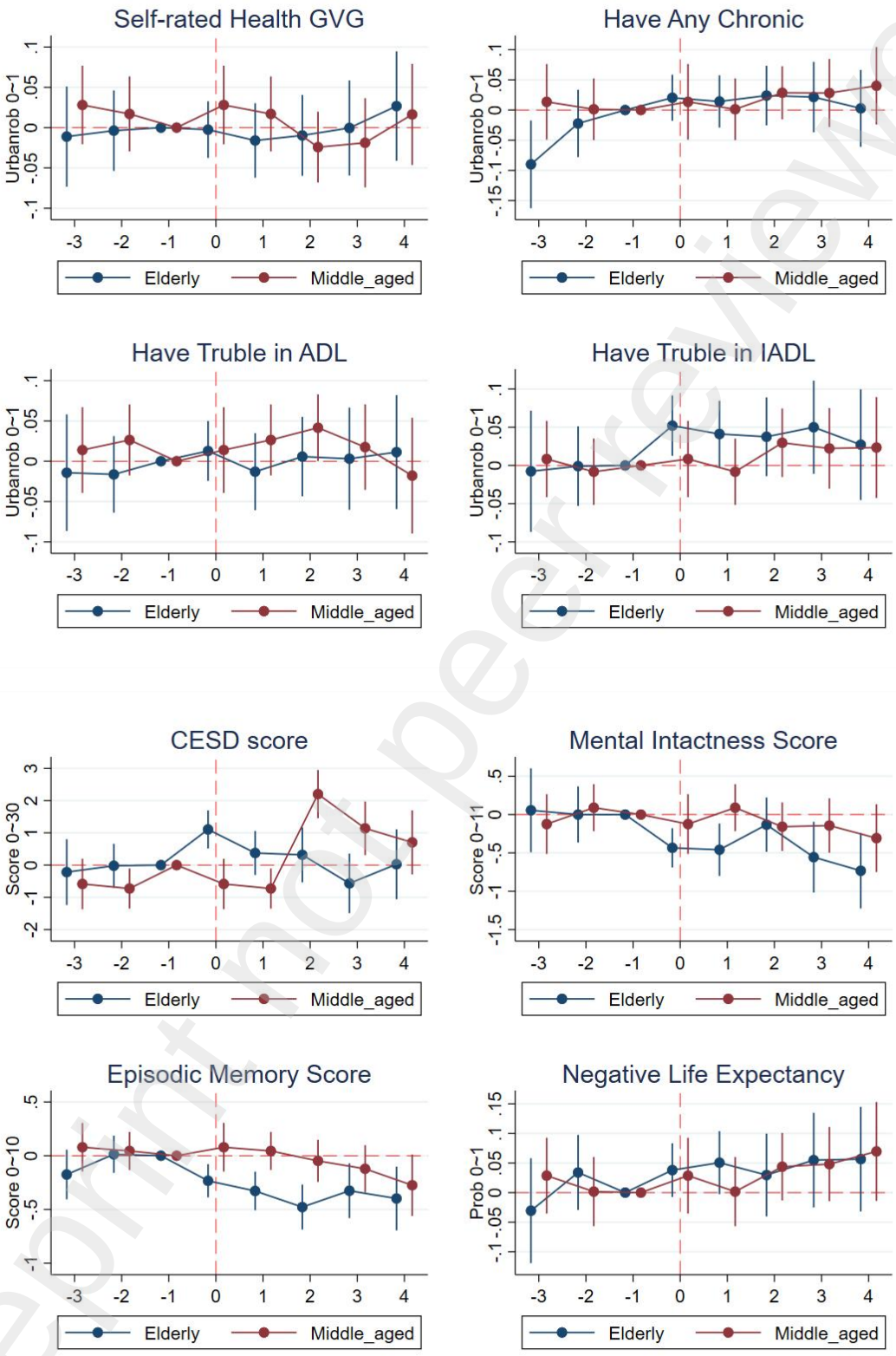
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
				Panel A: DID Estimator				
Elderly*Widowed	**0.0178**	**0.000139**	**-0.0110**	**0.0225**	**-0.965*** **	**-0.299** **	**-0.152** **	**0.00749**
	(0.0172)	(0.0169)	(0.0174)	(0.0175)	(0.277)	(0.129)	(0.0706)	(0.0203)
Widowed	-0.0284*	0.0287*	0.0201	0.0288*	2.103***	-0.134	-0.101	**0.0317**
	(0.0172)	(0.0159)	(0.0162)	(0.0173)	(0.289)	(0.119)	(0.0720)	(0.0200)
				Panel B: Dynamic Specification				
Interaction: Elderly	**0.0180**	**-0.00232**	**-0.0241**	**0.0232**	**-1.214*** **	**-0.325** **	**-0.171***	**-0.000706**
	(0.0229)	(0.0220)	(0.0223)	(0.0228)	(0.367)	(0.157)	(0.0933)	(0.0280)
Effect within 4 years	**-0.0282**	**0.0294**	**0.0300***	**0.0282**	**2.275*** **	**-0.125**	**-0.0888**	**0.0372**
	(0.0196)	(0.0181)	(0.0180)	(0.0195)	(0.335)	(0.132)	(0.0862)	(0.0242)
Interaction: Elderly	**-0.0268**	**-0.0140**	**0.0336**	**0.0517***	**-0.778***	**-0.00489**	**-0.0875**	**-0.0182**
	(0.0259)	(0.0267)	(0.0270)	(0.0275)	(0.424)	(0.199)	(0.110)	(0.0331)
Effect in 4-8 years	**0.0184**	**0.0433**	**-0.0175**	**-0.000538**	**1.430*** **	**-0.265**	**-0.304** **	**0.0476**
	(0.0275)	(0.0288)	(0.0307)	(0.0293)	(0.471)	(0.193)	(0.125)	(0.0368)
Interaction: Elderly	**0.0387**	**0.0255**	**-0.0252**	**0.00271**	**-0.471**	**-0.431** **	**-0.0740**	**0.0445**
	(0.0258)	(0.0292)	(0.0285)	(0.0296)	(0.407)	(0.201)	(0.114)	(0.0347)
Effect after 8 years	**-0.0211**	**-0.0186**	**0.0504**	**0.0370**	**1.569*** **	**-0.136**	**-0.337** **	**-0.00290**
	(0.0344)	(0.0377)	(0.0374)	(0.0398)	(0.551)	(0.241)	(0.157)	(0.0470)
Observations	65,173	68,772	66,614	66,673	56,760	44,943	58,468	51,402
Number of Individuals	19354	20054	19678	19688	17901	15086	18184	16856
R-squared	0.550	0.598	0.572	0.563	0.685	0.689	0.667	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 10.4. Heterogeneity: Middle Aged vs. Elderly



Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 11. Mechanism Heterogeneity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Self-rated Health Good or Very Good	Have Any Chronic	Have trouble in ADL	Have trouble in IADL	CESD Score	Mental Intactness Score	Episodic Memory Score	Negative Life Expectancy
Mean	**0.2414**	**0.4893**	**0.1869**	**0.2285**	**8.1357**	**7.9195**	**3.3816**	**0.3171**
Panel A: Drink vs. Not Drink								
Drink*Widowed	**0.0110**	**0.000502**	**-0.00132**	**-0.00988**	**-0.464**	**-0.0445**	**0.104**	**-0.00941**
	(0.0203)	(0.0191)	(0.0178)	(0.0219)	(0.298)	(0.143)	(0.0759)	(0.0268)
Widowed	**-0.0170**	**0.0287****	**0.0134**	**0.0455*****	**1.630*****	**-0.306*****	**-0.216*****	**0.0374****
	(0.0139)	(0.0131)	(0.0139)	(0.0144)	(0.232)	(0.0974)	(0.0614)	(0.0172)
Observations	65,114	68,698	66,576	66,633	56,733	44,920	58,440	51,381
Number of Individuals	19342	20042	19676	19685	17894	15081	18181	16853
R-squared	0.551	0.599	0.572	0.563	0.685	0.689	0.667	0.654
Panel B: Still Work vs. Not Work								
Work*Widowed	**-0.0296****	**0.00512**	**0.0242***	**-0.000166**	**0.475****	**-0.138**	**-0.00893**	**-0.0356***
	(0.0135)	(0.0150)	(0.0144)	(0.0149)	(0.229)	(0.0966)	(0.0608)	(0.0198)
Widowed	**-0.00189**	**0.0260***	**-0.00126**	**0.0376****	**1.270*****	**-0.248****	**-0.185*****	**0.0488****
	(0.0147)	(0.0143)	(0.0154)	(0.0154)	(0.242)	(0.107)	(0.0650)	(0.0190)
Observations	65,169	68,766	66,608	66,667	56,756	44,941	58,465	51,399
Number of Individuals	19353	20052	19676	19686	17899	15085	18183	16855
R-squared	0.550	0.599	0.573	0.565	0.686	0.689	0.667	0.654
Panel C: Have Social Activities vs. Not Have Social Activities								
Social*Widowed	**0.00908**	**-0.00463**	**-0.0183**	**-0.0249***	**-0.00243**	**0.103**	**0.0510**	**-0.00960**
	(0.0118)	(0.0132)	(0.0130)	(0.0131)	(0.184)	(0.0922)	(0.0467)	(0.0168)
Widowed	**-0.0152**	**0.0291***	**0.0226**	**0.0573*****	**1.515*****	**-0.381*****	**-0.226*****	**0.0403****
	(0.0146)	(0.0156)	(0.0155)	(0.0163)	(0.247)	(0.110)	(0.0673)	(0.0186)
Observations	61,561	62,876	60,984	61,032	55,305	43,591	57,010	50,037
Number of Individuals	18590	18876	18520	18533	17613	14798	17918	16562
R-squared	0.557	0.610	0.571	0.554	0.687	0.691	0.667	0.654

Note: *1. All regressions controlled for individual fixed effect and time fixed effect, and time fixed effect was the time effect at the community level. 2. All regressions control the necessary cross term of the predetermined covariate and time. 3. In parentheses is the robust standard error of clustering at community level. 4. Observations do not correspond exactly to descriptive statistics because singleton observations are omitted in the estimation of high dimensional fixed effects. 6.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231

Appendix 12. Mechanism Variables

VARIABLES	(1) Drink	(2) Have Social Activities	(3) Still Working	(4) Outpatient	(5) High Level Outpatient	(6) Inpatient
Female	0.0358*	-0.0567***	-0.286***	0.0141	-0.00993	-0.00307
	(0.0199)	(0.0168)	(0.0178)	(0.0130)	(0.00809)	(0.0129)
Urban	-0.0311	-0.565***	-0.279***	-0.0413	0.0298	0.529***
	(0.0428)	(0.0358)	(0.0404)	(0.0299)	(0.0223)	(0.0329)
Age	-0.00150*	-0.0203***	-0.00233***	-0.00175***	-0.00117***	0.00204***
	(0.000840)	(0.000765)	(0.000666)	(0.000640)	(0.000400)	(0.000607)
Agriculture Hukou	-0.0260	0.0595*	0.0220	0.0210	0.00724	-0.0379
	(0.0332)	(0.0312)	(0.0266)	(0.0252)	(0.0167)	(0.0269)
Senior High and Above	0.130***	-0.0710**	0.0158	-0.0322	-0.00510	0.00941
	(0.0392)	(0.0312)	(0.0382)	(0.0289)	(0.0245)	(0.0295)
Health Status	Yes	Yes	Yes	Yes	Yes	Yes
Community FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,510	6,841	6,835	6,829	6,825	6,833
R-squared	0.155	0.359	0.259	0.144	0.126	0.152

Note: *1. The regressions are limited to the group of people who have been widowed. 2.All regressions controlled for health conditions. 3. In parentheses is the robust standard error of clustering at community level. 4.* p<0.1, ** p<0.05, *** p<0.01.*

Preprint not peer reviewed

This preprint research paper has not been peer reviewed. Electronic copy available at: https://ssrn.com/abstract=4649231