“Impacts of Family Caregiving Intensity and Duration on Working Caregivers in Japan: Balancing Work and Caregiving”

Aoyama Gakuin University
Saki Sugano[1]

Abstract

As the number of individuals balancing caregiving and employment rises in Japan, this study investigates the impact of informal caregiving for parents – including caregiving provision, intensity, duration, and nursing home use - on the labor supply of middle-aged children. Using panel data and instrumental variable estimation with parents' certified long-term care levels as instruments, the results show that caregiving, as well as its duration and intensity, significantly reduces both the likelihood of employment and working hours, especially for women. Beginning to give care more than doubles the odds of labor force exit. When caregiving duration expands over multiple years, each additional caregiving wave (about two years) leads to a 8.4 percentage point reduction in employment probability, highlighting the cumulative burden of prolonged caregiving. Caregiving intensity is strongly associated with reduced work hours, with a 1% increase in caregiving time leading to a 0.41% reduction in working hours. Caregiving also affects mental health adversely for women and even for full-time workers. These findings emphasize the need for targeted policies to support caregivers who need to balance between working and caregiving.

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1. INTRODUCTION

As Japan’s population continues to age, the demand for elderly care is projected to increase significantly, with the entire baby boomer generation reaching 75 years of age around 2025. In 2022, 58.0% of individuals who provide informal care were also employed, with the highest proportion observed among those aged 50 to 54. Those people - referred to as “business caregivers”- are increasing in number, and they will reach approximately 2 million (11.8% of the population) in 2033 from 750,000 (4.4%) in 2023 according to estimates by the Japan Research Institute. At the same time, an increasing number of individuals leave their jobs to care for family members, becoming what are known as “care leavers”. As these numbers rise, Japan’s labor market, which increasingly depends on women and older adults, faces substantial pressure in the following three points: it often acts as barriers to career advancement, causes income loss, and may impose mental burden on caregivers. According to estimates by the Ministry of Economy, Trade and Industry, Japan could face an economic loss of 9 trillion yen by 2030 due to the difficulties of balancing work and caregiving responsibilities. Therefore, understanding the impact of informal caregiving on labor supply is crucial to mitigating such economic losses for both individuals and Japan as a whole.

Facing an aging population, the Japanese government started the public long-term care (LTC) insurance system in 2000, designed to shift caregiving responsibilities which was initially a personal family burden only to be taken up by society in its entirety. Eligibility for benefits requires certification of care needs, which is determined through an objective and standardized process conducted by municipalities. Based on the certified LTC need level, municipalities determine the appropriate care and support services for each individual. Individuals can receive caregiving services at home, such as visits from professional caregivers (who are called “helpers”) or they can reside in nursing care facilities. Individuals pay 10% of the cost for long-term care services, with the remainder subsidized by the government. While this system potentially reduces the burden on family caregivers and helps mitigate the negative impact on labor supply, there is limited empirical evidence on its effectiveness in practice.

There are several studies on the impact of family caregiving on labor that have been analyzed in Japan and other advanced countries. The findings generally suggest that informal caregiving has only modest effects on labor market outcomes. In Japan, caregiving reduces the probability of female employment only

[1] Saki Sugano (ORCID: 0000-0001-7921-4287)
College of Economics, Aoyama Gakuin University, Tokyo, Japan.
E-mail: sugano@econ.aoyama.ac.jp
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by 3.2% (Oshio and Usui, 2018). Shimizutani et al. (2009) shows there are no consistent and significant effects of the introduction of the public LTC system in 2000 on women's labor supply. Nakamura (2014) found that there was a negative effect for those who lived with an elderly person in need of care, but the effects diminished over time. Availability of nursing homes has no impact on labor supply (Kondo, 2017). Similarly, studies in the United States and Europe report mixed evidence of substantial employment reductions (Bauer and Sousa-Poza, 2015; Crespo and Mira, 2014; Lilly et al., 2007). The extent of the impact appears to vary depending on factors such as co-residence, the intensity of caregiving in terms of hours (Kumagai, 2017; Kaschowitz and Brandt, 2017), the duration over which caregiving responsibilities lasts (Oshio, 2015; Fuino and Wagner, 2020; Simard-Duplain, 2022), and the care recipient's relationship to caregivers, i.e., parent, parent-in-law, spouse, etc. (Bolin et al., 2008a; Geerts and Van den Bosch, 2012; Do et al., 2015).

This study focuses on three critical aspects of caregiving's impact on labor supply. First, it investigates how caregiving hours compete with working hours for adult children balancing employment and caregiving responsibilities. Historically, caregiving responsibilities were predominantly undertaken by stay-at-home women and part-time workers, whose working hours were relatively short. However, recent data shows that the number of employed women in Japan has reached a record high. In 2023 (Ministry of Internal Affairs and Communications, 2023), and the number of both men and women balancing work and caregiving is rapidly increasing. Despite this trend, much of the existing research on Japan has focused on the extensive margin of labor supply (likelihood of employment) of women, while little research has been employed on the intensive margin, such as the effect of caregiving on the number of hours worked for both men and women.

Second, the study addresses endogeneity in estimating the causal effect of caregiving on labor supply. Caregiving and labor supply are interrelated, as the decision to provide informal care may depend on employment status. This makes it difficult to disentangle whether caregiving reduces labor supply or if individuals with lower labor market attachment are more likely to take on caregiving responsibilities. Addressing this issue requires an appropriate estimation strategy to mitigate potential bias and much of previous literature uses an instrumental variable (IV) approach or propensity score matching method. For instance, parental health status is frequently used as an instrument to estimate the causal effect of informal caregiving on the caregiver (Pingquart and Sorensen, 2003, 2007; Coe and Van Houtven, 2009; Crespo and Mira, 2014; Do et al., 2015). Other studies have used the number of the siblings (Coe and Van Houtven, 2009) or geographical proximity between parents and children as instruments (Charles and Sevak, 2005; Stern, 1995; Bonsang, 2009). This study employs an IV estimation using parent's long-term care need certification level as an exogenous indicator of parent's health and caregiving need (Coe, et al., 2009; Oshio and Usui, 2018; Heitmueller., 2007).

Third, caregiving's duration is a critical factor often overlooked. Unlike childcare, elderly care often involves unpredictable and extended commitments. According to the 2021 National Survey on Life Insurance, the average length of nursing care among current caregivers is 61.1 months, with 17.6% of respondents providing care for over 10 years. This indicates that caregiving often persists far beyond the average reported duration. As the caregiving condition lasts longer, family caregivers are likely to adjust their labor supply by reducing their working hours or retiring early. While previous studies have largely measured the effect of informal care provisions at a single point in time, few studies have accounted for the impact of caregiving duration (Oshio, 2015; Fuino and Wagner, 2020; Simard-Duplain, 2022).

Building on these concerns, this study utilizes the Japanese Study of Aging and Retirement (JSTAR), a panel dataset of middle-aged and older adults in Japan. To draw international comparisons, I also conducted the same analysis using the Survey of Health, Ageing and Retirement in Europe (SHARE), a panel dataset of middle-aged and older adults in Europe that is designed to be comparable with JSTAR. The primary contribution of this paper lies in its examination of the prolonged effects of caregiving through panel data, careful control for endogeneity, and focus on middle-aged and older children providing care to parents and parents-in-law, the most common caregiving dynamic in Japan. The analysis also explores gender differences to determine whether women disproportionately bear the burden of caregiving. A comparison between Japan, where gender inequality is more pronounced, and European countries reveals that Japanese women are more likely to reduce their labor force participation and working hours in response to caregiving responsibilities. Furthermore, this study finds that children who are managing both caregiving responsibilities and paid work suffer a decline in their mental health.

This study finds that informal caregiving significantly reduces working hours, particularly for women and part-time workers. A 1% increase in caregiving hours per week is associated with a 0.21% to 0.41%[2] decline in weekly working hours for women. In contrast, no similar trend was found in European data. However, caregiving also leads to a statistically significant reduction in working hours for men as the duration of caregiving extends, underscoring the importance of acknowledging its prolonged nature. Part-time workers experience a greater reduction in working hours compared to full-time workers, who had limited flexibility to adjust their work schedules at the time of the survey. Even when parents live in nursing homes, women tend to reduce their working hours. This may reflect the continuation of care responsibilities, including daily caregiving tasks such as visiting the facility, managing laundry, and coordinating with staff. Women who provide care to co-living parents deteriorate their mental health.

The remainder of this paper is organized as follows. Section 2 provides details about the data and descriptive statistics. Section 3 presents the empirical model and section 4 presents the results. Section 5 discusses the results and concludes the findings.

2. DATA

The analysis in this paper is based on data from the Japanese Study of Aging and Retirement (JSTAR), which is a survey of middle-age and elderly people aged 50 or older in Japan, conducted in 2007, 2009, 2011 and 2013[3] by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University and the University of Tokyo. It is designed to ensure comparability with the Health and Retirement Study (HRS) in the U.S., the Survey of Health, Aging and Retirement in Europe (SHARE) in Europe and the English Longitudinal Study of Aging (ELSA) in U.K (Ichimura et al., 2009). In the later sections, I use SHARE wave 1, 2, and 4 to enable international comparisons later[4].

JSTAR is the one of the most appropriate datasets in Japan to analyze the impacts of informal care on family caregivers' work because the respondents are the age group most likely to serve as primary caregivers. It includes information on the provision of family care (time, frequency, and to whom), whether the respondents live with or separately from his/her parents or parents-in-law[5], and the information on the level of LTC care of the parents and parents-in-law as well as the health and socio-economic variables of the respondents. The levels of LTC care are indicators of the health of elderly individuals, officially assessed through a public evaluation process under Japan's public long-term care insurance system. While Oshio and Usui (2018) focused their analysis on respondents who were Japanese women aged 50-59, my study includes both men and women in the analysis due to the fact that given the rising labor force participation of women, understanding gender differences in how caregiving affects labor supply is a key concern. In the robustness check, the analysis is restricted to those under the age of 61 as in Oshio and Usui (2018) in order to maintain comparability.

2.1 Caregiving and parent variables

The main variables in this study are summarized in Table 1 and Table 2. I restricted adult children who have at least one living parent or parent-in-law. The number of respondents were 1,853 in 2007, 1,846 in 2009, 1,869 in 2011, and 1,370 in 2013.

The informal caregiving dummy variable is constructed based on the following question:

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[2] As I will discuss in Section 2, there are two types of survey items regarding caregiving hours, depending on the wave. The first approach calculates caregiving hours as the amount of time the parent requires care, multiplied by a dummy indicating whether the respondent is the caregiver. The second approach, used in the 2011 and 2013 waves, directly asks respondents how many hours they personally provide care to their parents.

[3] The first wave of survey carried out in five cities in 2007. The second wave survey, conducted in 2009, included a follow-up of the respondents from the 2007 survey and an initial survey of respondents in two additional municipalities, bringing the total to seven cities. Next 2011 survey includes a follow-up survey of these previous two waves in seven cities plus an initial survey of respondents in three additional municipalities, resulting in a total of 10 cities. The final survey was conducted as a follow-up of respondents across all 10 cities in 2013, which was the latest survey.

[4] The first wave of SHARE was collected in 2004/2005 in 12 European countries (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel,) and the second wave in 2006/2007, which added the Czech Republic, Ireland and Poland and the fourth wave in 2011, which added Hungary, Portugal, Slovenia, and Estonia. SHARE third wave in 2008/2009 collect life history survey, and I do not use it in this study. Since SHARE wave 4 does not contain information of caregiving hour, I use SHARE wave 4 for the analysis except for caregiving hour. The sample in this research are limited to those who are aged 50-80 and those who have at least one parent or parent-in-law.

[5] Hereafter, unless otherwise stated, parents and parents-in-law are indicated together as parents.

(i) Do you provide care for your father/mother/father-in-law/mother-in-law?

Respondents answered "yes" are coded as 1, indicating that they provide informal care to parents or parents-in-law while those who answered "no" are coded as 0[6]. However, it is important to note that the first wave (2007), the two cities added in second wave (2009) , and the three cities added in the third wave (2011), the presence or absence of caregiving is assessed based on the different questions that capture both current caregiving and future intentions to provide informal care for parents or parents-in-law:

(ii) Do you provide care for your father/mother/father-in-law/mother-in-law? Do you plan to provide care for him/her?

Therefore, it is necessary to exclude future possibility and use the information whether parents required care at the time of the survey. To do so, I use the following question:

(iii) "Does your father/mother/father-in-law/mother-in-law need nursing care? If so, approximately how many hours per day is he in need of care? (Including care at home and temporary use of an institution. If he/she is in an institution, please answer in that way. The time spent in care does not include time spent commuting to and from work."

Response options:
1.He/she is in need of care at home (about X hours a day),
2. He/she is in a nursing home,
3. Not in need of care,
4. Don't know,
5. Refuse to answer.

If the respondent answers "yes" to the question (ii) and selects option *"1. He/she is in need of care at home (about X hours a day)"* in the question (iii), he/she is defined as providing informal care[7].

Regarding the nursing home use, if the respondent chooses "*2. He/she is in a nursing home"* of these options in the question (iii), the variable of nursing home use is taken as 1, otherwise 0. Regarding caregiving hours, there are two ways of measuring. (I) in-home interviews using a computer, which the questionnaire shows above, and (II) a self-administered placement questionnaire, completed through a follow-up visit or via mail return. From the question in (I) the computer-based in-home interview survey, in the first wave survey in 2007, the two cities added in second wave in 2009, and the three cities added in the third wave in 2011, the respondents were not directly asked hours of caregiving, but they were asked how many hours of care does your father need[8] as in the above question (iii) . The option *"1. He/she is in need of care at home (about X hours a day)"* is multiplied by the *"Are you caring for that parent or not"* dummy to get the data on *X* which is the hours of care per day. It should be noted that the hours of care required for the parent may possibly include professional care services at home using public long-term care insurance, but the data does not tell us whether or not public LTC "home" care services are used. The other survey (II) asks respondents how many hours per day they provide care to their family members on weekdays and on weekends respectively. This is used to derive the hours of care per week from using a calculation of weekday care hours times five days plus weekend care hours times two days. I define high intensity of caregiving as 20 or more hours per week and low intensity as less than 20 hours per week. In the analysis, these caregiving hours per day by the question (I) and per week by the question (II) are logged-transformed. Furthermore, in a 2011 survey conducted in the seven continuing cities from the 2009 wave and in all ten cities in 2013, respondents were directly asked the number of hours care provided per day. I multiplied the reported daily caregiving hours by seven to calculate weekly caregiving hours, which I use as an additional caregiving intensity variable in the analysis.

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[6] I consider individuals as caregivers when they provide informal care to their parents or parents-in-law, not their spouses nor other family members.

[7] This method of defining informal caregiving is consistent with prior studies using JSTAR data, including Wakabayashi and Kureishi (2018) and Le and Ibuka (2023).

[8] The questions also ask the hours of care the respondent's mother, father-in-law, mother-in-law required.

Taking advantage of the characteristics of panel data for four waves, I also analyzed the impact of duration of care. Due to the different start dates of the survey depending on the municipality in which they live, respondents can only be observed at a maximum of four times. The duration of caregiving is defined as 8 years if the person has provided care for four consecutive survey terms, 4 years if the person has provided care for two consecutive survey terms (for example, 2007 and 2009 or 2009 and 2011), and 2 years if the person has provided care for only one term. In the latest wave 4 in 2013, among 1,068 respondents, there are 688 (64.42%) respondents who have never been involved in informal caregiving, 262 people (24.53%) have been involved in for one survey, 87 people (8.15%) have been involved in two surveys, 26 (2.43%) have been involved in three surveys, and 5 (0.47%) have been involved in four surveys. For the sample survey starting in 2007, the results of this study are at the lower end of the range, since some of the respondents continued to care for their living parents before 2007 or after the latest 2013 survey. Therefore, it should be recognized that the estimated impact of caregiving duration represents a lower bound.

In Table 1, Panel (A) summarizes information about the respondent's own parents and their spouse's parents. Overall, a greater proportion of respondents report that their mothers are still alive compared to their fathers. This pattern also holds for their spouse's parents. The average age of both fathers and mothers is approximately the same, around 85 years. Among living parents, 25% of fathers and 33% of mothers require care, indicating that mothers are slightly more likely to need care. Similarly, a higher proportion of mothers reside in care facilities compared to fathers (16% vs. 10%). In Panel(B), the certified LTC level of parents or parents-in-law are described. The LTC level used in the analysis is the highest level of LTC among fathers, mothers, fathers-in-law, and mothers-in-law. The LTC levels are classified into seven levels, which help to quantify the intensity of care needs. These levels are essential for understanding the caregiving burden that individuals may face:

1. Support Level 1 and Support Level 2: These are mild care levels where individuals require some assistance but are relatively independent with Level 1 being the lowest requirement.
2. Care Levels 1 through 5: These levels indicate progressively severe care needs, with Care Level 5 representing the most intensive care requirements.

There is also a category for individuals deemed “Not certified”. 32.6% of respondents reported that their parents/parents-in-law were officially assessed to need long-term care, while 67.4% of respondents answered that their parents/parents-in-law were not certified. In Table 1 Panel (C), caregiving-related variables are summarized. Of the 6,938 samples, 20 % (N=1,357) were involved in caregiving for either their own parents or their spouse’s parents. There are cases where some of them (N=558) answered that they are "providing care" even when their parents are in a nursing home. This may reflect situations where, despite the parent being institutionalized, the individual still visits or brings clothing and daily necessities. Among the 2,027 individuals living with their own or their spouse’s parents, 21 % were caregivers. In contrast, among 5,728 individuals living separately from their own or their spouse’s parents, 17 % were caregivers. It is evident that living together increases the likelihood of providing care in Japan. In the full sample, including individuals who do not provide care, the average weekly caregiving time is 2.7 hours, and the average daily caregiving time is 0.65 hours. Among those who provide care (N=1,375), the average weekly caregiving time is 10.24 hours, which is close to the average obtained from direct questions on caregiving hours in 2011 and 2013 (9.26 hours). The average daily caregiving time is 3.32 hours. The differences between weekly and daily average caregiving hours stem from the use of different survey questionnaires, as described above. The former is collected through a leave-behind questionnaire answered via mail, while the latter is derived from the main survey. Regarding the duration of caregiving, the average duration for the full sample (including non-caregivers) was 0.32 periods × 2 years = 0.64 years, while the average for caregivers who provide care at least one time in four survey periods was 1.28 periods × 2 years = 2.56 years. Lastly, 22% of individuals have parents/parents-in-law residing in a nursing home.

2.2 Instrumental variables

There are endogeneity problems of caregiving decisions. Those who decide to provide informal care tend to reduce their labor supply or working hours. Simultaneously, those who work less hours of work tend to provide informal caregiving and may not use the nursing homes for their parents. To adjust for potential endogeneity bias, a Two Stage Least Squares (2SLS) estimation is applied (Heitmuller, 2007). As instrumental variables for the caregiving decision, parent’s certified LTC need level are possible candidates. Since the LTC need level is the objective score of a parent's health status, it has a significant impact on the caregiving needs, but it does not directly affect children’s labor supply.

Care needs are categorized into one of seven levels. The assessment considers various factors, including physical functionality, activities of daily living, cognitive abilities and other relevant aspects. The more a parent's LTC level increases, i.e., the greater the need for care, the greater the probability of care and the longer time and duration of care. At the same time, as the LTC needs become more severe, the more the probability of using nursing home care increases instead of informal care at home.

Figure 1 Panel(A) illustrates the number of individuals who do not provide care, provide informal care, or have a parent residing in a nursing home, by the LTC certification level of their parents. It indicates that as the LTC level increases, both the number of informal caregivers and whose parents are in nursing homes increase, with the increase being more pronounced for the latter. Panel (B) presents the average hour of caregiving per week and per day. The intensity of caregiving increases up to care level 2, but declines slightly thereafter. This decline is likely attributable to the fact that parents with care level 3 or above often require extensive care that is sometimes difficult to provide at home, resulting in a higher rate of nursing home placement.

To examine how the likelihood of providing informal care and using institutional care changes with the severity of a parent's care needs, I estimated a linear probability model using the parent's certified LTC level and its squared term as explanatory variables. Control variables included the child's gender, health status, income, and other individual characteristics. Using the estimated coefficients from this first-stage regression, I then simulated predicted probabilities of both informal caregiving and nursing home use. Specifically, I generated 100 hypothetical LTC levels ranging from 0 to 7 and calculated the predicted values for each level. The results show how caregiving behavior responds to different levels of parental care needs and are presented graphically in Panel (C). In Table 2, examining the coefficient of the level and the squared term for LTC level, I find that it is statistically significant and positive for the level and negative for the squared term. This indicates an inverted U-shaped relationship between LTC level and informal care hours. In other words, the number of people providing informal care increased as the parent's LTC level increased but tended to decrease after level 4 which is equivalent to Care Level 2. On the other hand, the number of users of nursing homes increases with each level of care required. The results show that a higher level of parental care is positively and significantly associated with nursing home use. This situation shows that informal care does not have a linear relationship with the LTC level, but that it is more fitting to include a squared term, which represents an inverted U shape. Therefore, the square of the parent's LTC level is also included as the instrumental variable. In the existing literature, Le and Ibuka (2023) use a dummy variable whether the respondent's parent requires long-term care as IV. Lee and Horioka (2025) constructs a dummy variable equal to one if the parent's LTC certification level is three or higher. However, as shown earlier, caregiving provision and intensity vary significantly depending on the parent's LTC level. Therefore, using the detailed LTC level as an instrumental variable may allow for a more accurate capture of caregiving behavior.

To assess the validity of IV, I tested the conditional independence assumption that parents' LTC level affects the provision of informal care but does not directly affect the outcome variables such as labor supply, once potential confounders are controlled. Following Le and Ibuka (2023), I restricted the sample to those who never provided care and examined whether IV was correlated with labor supply. The result indicated no significant association, supporting the validity of the conditional independence assumption.

2.3 Descriptive results

Table 1 Panel (D) presents descriptive statistics of the main variables, using four waves from JSTAR and three waves (waves 1,2, and 4) from SHARE, separately for caregivers and non-caregivers. Panel(D) shows that the average age of caregivers was 61.22 years old, while that of non-caregivers was 59.97 years old in JSTAR, while 56.95 for caregiver and 57.67 for non-caregiver in SHARE. In Van Houtven et al. (2013)'s HRS sample, the average age of female (male) caregivers was 55.521(57.883) years, and for never caregivers, it was 56.265 (58.967) years. Caregivers were, on average, younger than never caregivers in their sample in the JSTAR, but a different trend can be observed in SHARE used in this study.

Next, regarding employment status in Japan, 75% of individuals are employed, with a significant difference between caregivers (65%) and non-caregivers (76%). Among those who are employed, the average weekly working hours are 38.84 hours, not shown here. Caregivers work an average of 35.92 hours, while non-caregivers work an average of 39.45 hours. The differences in labor supply between caregivers and non-caregivers are likely due to differences in the characteristics of individuals who become caregivers. Therefore, it is necessary to control for the socioeconomic variables associated with who becomes a caregiver. For example, caregivers are hypothesized to be younger, have lower educational attainment, work fewer hours, or be in better health. These variables need to be controlled. In Table 2, it is

observed that more caregivers are female (1.56 vs. 1.43), have fewer children (1.93 vs. 1.98), are in slightly worse health (2.38 vs. 2.36).

3 EMPIRICAL ANALYSIS

The goal of this study is to assess the effect on a caregiver's labor supply and mental health by informal caregiving. As previously noted, this analysis focuses on controlling for the endogeneity of informal caregiving decisions through the standard approach of instrumental variables estimation. As for instrumental variables for the informal care, possible candidates are the certified LTC levels and its square, as it is likely to be correlated with the amount of care needed, which in turn influences the provision, intensity, and duration of informal care, as well as a nursing home utilization. I specify the following reduced form for models of informal caregiving decision (1) and outcomes of labor (2):

$$C_{it} = \beta_0 + \beta_1 H_{it} + \beta_2 x_{it} + \varepsilon_{1it} \quad (1)$$
$$Y_{it} = \alpha_0 + \alpha_1 \widehat{C}_t + \alpha_2 x_{it} + \varepsilon_{2it} \quad (2)$$

where C_{it} is the caregiving variables in wave t = 1, …, 4 for individual i = 1,…, n and Y_{it} is the labor supply dummy and log hours of work[9], which estimate separately. In equation (1), H_{it} indicates the instrumental variables, here LTC level and its square, which determine the caregiving decision. x_{it} are characteristics of children, that is, age, age squared, gender, marital status, number of children, five levels of self-reported health (from 1. Excellent to 5. Poor), quantile of log of per capita household income and educational categories.

The main interest of caregiving variables consists of dummy variables whether the respondent provides informal care to their parents or not, to their parents who live together or separately, hours of care, duration of care, and nursing home use. To be more precise, caregiving hours are weekly and daily log transformed informal care hours plus one to include the people not providing informal care with zero hours of caregiving. This transformed care hours variable is employed in those of Van den Berg and Ferrer-i-Carbonell (2007) and Van den Berg et al.(2014).

4 RESULTS

4.1 Impact of caregiving on employment probability (Extensive margin)

First, I conducted the estimation of caregiving on employment, i.e., the extensive margin, using an OLS model and 2SLS model with IV for men and women separately, shown in Table 3. The dependent variable in all models is a binary indicator of paid work, taking a value of 1 if the individual is employed and 0 otherwise. In this case, I used the linear probability model, as it has been widely employed in previous studies (Oshio & Usui, 2018; Simard-Duplain,2022; Crespo, & Mira, 2014; Heitmuller, 2007; Leight, 2010), allowing for direct comparison of results. The Durbin-Wu-Hausman test fails to reject the null hypothesis of exogeneity except for mainly men, suggesting that care provision may be treated as exogenous in this setting and OLS estimates may still be valid. Nevertheless, as individuals with lower labor market attachment may be more likely to take on caregiving responsibilities, I test whether the proposed instrumental variables satisfy the condition for being valid. The first stage F-test rejects the null of weak instruments and passes the overidentification test. This finding is consistent with the results of Usui and Oshio (2018), who also reported no strong evidence of endogeneity in caregiving decisions. Therefore, Table 3 reports the estimates from OLS alongside the 2SLS results. Panel (A) focuses on two key indicators: a dummy for care provision and the nursing home utilization. In the OLS estimation, caregiving to parent has a negative impact on labor supply, with a 4.5% reduction in the probability of employment for men and 5.0 % reduction for women[10]. These findings are consistent with prior research by Oshio and Usui (2018), who found that caregiving reduces employment by 5.4% among women under the age of 60, and by Heitimuller (2007), which shows 5.76% reduction in England. The results of 2SLS shows that providing care significantly reduces the probability of being employed by 10.4 percentage points, however, the Hausman test fails to reject the null hypothesis that caregiving is exogenous to labor supply.

[9] The value of hours of work is conditional on employment. Thus, it is set to a missing value for individual not working.

[10] While a smaller amount of negative effect was observed in the FE model, it was not statistically significant. This difference can be attributed to the fact that the FE model controls for individual-specific characteristics that do not change over time, such as household role expectations (e.g., the perception that caregiving is a woman's responsibility), consistent behavior patterns in the labor market, and work motivation.

When parents are in a nursing facility, the probability of employment decreases by 3.4% for men and 5.3% for women, with more impact for women. As shown in Figure 1, individuals who enter institutional care typically have a high level of care needs. Consequently, when a parent reaches such a severe level of dependency that institutionalization becomes necessary, their adult children may have already withdrawn from the labor force to provide care. Next, among those with non-co-residential parents, men are 6 percentage points less likely to be employed. For women, endogeneity may be a concern as suggested by the Wu-Hausman test $p = 0.0563$, and 2SLS results show a substantially larger effect: caregiving reduces the probability of employment by 20.1 percentage points. Caregiving for non-co-resident parents often involves commuting to the parent's home, which may force individuals to reallocate their time and leave the labor market.

I next examined the effect of caregiving intensity on labor supply in Panel (C). Using 2SLS estimation, since there is an endogenous issue as checked by the Wu-Hausman endogeneity test, the results show that mainly women are affected by caregiving. An additional two years of caregiving is associated with an 8.4 percentage point decline in the probability of being employed. A 1% increase in weekly caregiving hours reduces the probability of being employed by approximately 5.5 percentage points for women. Similarly, when daily caregiving hours are used instead, a 1% increase leads to a 9.3 percentage point decline in employment likelihood. These results indicate that not only caregiving status, but also its intensity, plays a substantial role in reducing labor market participation. Hours of informal caregiving and duration of caregiving also matter in Europe (Bolin et al., 2008). Sinard-Duplain (2022) shows that women aged 55 to 64 who provide care for more than six months reduce their labor supply by 16.1 percentage points. The findings in this study complement these other studies while the figures in this study are smaller compared to those reported in previous studies. The cumulative impact on labor market participation may become substantial as caregiving extends over time. This suggests that even small changes in caregiving hours can lead to significant long-term effects and the effects seem to persist as Schmitz and Westphal (2015) found.

Lastly, this study compares the robustness check with the findings of Oshio and Usui (2018), who focused on women under the age of 60 and reported a 5.4% reduction in labor supply based on OLS estimates. In our robustness check restricting the sample to women under 60, 2SLS estimation results do not find statistically significant evidence that caregiving leads to labor force exit. These results highlight the importance of considering the care recipient's living arrangement when evaluating the labor market consequences of caregiving.

To investigate further the association between starting of giving care and labor force exit, I utilized an event study method. The main explanatory variable is a dummy variable that equals 1 if the respondent started providing informal care to a parent in that wave but not in the previous wave, and 0 if they were continued to not provide care or provide care. The dependent variable is a binary indicator equal to 1 if the respondent, who was initially employed, exited the labor force in a given wave, and 0 otherwise. This variable captures the initiation of caregiving, which is hypothesized to affect employment continuity. The logit estimation is conducted with control variables including age, age squared, gender, marital status, and self-rated health, education and income quantile. As shown in Table 4, contrary to the results from OLS and 2SLS estimation above, the odds ratio for the caregiving initiation dummy is 1.27 and statistically significant for men, but not for women. Men who begin caregiving are 1.27 times more likely to exit the labor force than those who do not.

4.2 Impact of caregiving on hours of work (Intensive margin)

Next, I present the analysis results on the impact of caregiving on working hours, which is the main focus of this paper. The dependent variable is the logarithm of weekly working hours. There are two reasons why working hours are given the most attention. First, with the growing number of people who balance caregiving and employment, a trend that is expected to increase further in the future, I aim to show whether working hours are being sacrificed to manage both responsibilities. Second, related to the first reason, the pension eligibility age has been delayed in Japan as well as other developed countries, and many people continue to work beyond the age of 60. These individuals are increasingly taking on diverse working arrangements, such as being rehired by the same company with lower wages compared to their previous positions, working in different positions compared to their previous full-time roles, or working at different companies. For these reasons, I focus not only on whether caregiving affects the decision to participate in the labor market but also on how it impacts working hours.

In analyzing caregiving and working hours, I tested for the presence of endogeneity. The Durbin-Wu-Hausman test strongly rejected the null hypothesis of exogeneity, confirming the necessity of an instrumental variable approach. The first-stage regression showed that the instruments were strongly

correlated with the endogenous regressor, far exceeding the conventional threshold of 10, thus alleviating concerns about weak instruments. Overidentification tests indicated that the instruments were valid and exogenous. This suggests that the caregiving variables—whether caregiving is provided, the hours, duration, and use of facilities—are indeed endogenous. In other words, caregiving is correlated with the error term, indicating the presence of endogeneity issues. Therefore, to mitigate this bias, I estimate 2SLS models with instrumental variables of certified LTC level and its square. Given that the instrument—the parental care need level and its square—is continuous and exhibits a non-monotonic relationship with caregiving behavior, the IV estimates should not be interpreted as Local Average Treatment Effects (LATE) in the sense of Imbens and Angrist (1994).

Table 5 presents the 2SLS estimation results of the effect of informal caregiving on working hours, measured as the log of weekly working hours by gender. For women, caregiving was found to significantly reduce working hours. For women, providing care to a parent is associated with a 34.8 % reduction in labor hours which corresponds to the coefficient = –0.429 (exp(-0.429)-1 = 0.348), and each additional two-year caregiving period (measured by the number of waves) is associated with a 24.85% reduction (coefficient = –0.286). Both estimates are statistically significant, indicating a pronounced negative effect of caregiving on women's labor supply. Having a parent residing in a nursing home is associated with a significant reduction in labor supply. The estimated coefficient of –0.319 implies that women whose parents are institutionalized work approximately 37% fewer hours compared to those whose parents are not. This indicates that using a nursing home reflects the already substantial care needs of parents entering such facilities, suggesting that women may have adjusted their working hours prior to admission to manage caregiving responsibilities. Caregiving for a co-residing parent significantly reduces labor hours among men, with an estimated effect of –0.307 (≈ 26.5% reduction). This reflects a cultural norm in Japan, where men are expected to live with and care for their own aging parents, potentially adjusting their labor supply in response to caregiving needs.

Furthermore, caregiving intensity which is measured by the duration of caregiving, the logarithm of weekly and daily caregiving hours also shows a significant negative effect for women. Specifically, a 1% increase in weekly caregiving hours reduces women's labor supply by approximately 0.414%, while a 1% increase in daily caregiving hours results in a 0.350% decline. These findings suggest that women do respond significantly to the intensity of care provided.

Next, Table 6 presents the results by employment type. It is expected that part-time workers would adjust their working hours more significantly due to caregiving compared to full-time workers. Indeed, as shown in Table 6, part-time workers reduce their working hours by 0.383% and full-time workers reduce by 0.006% due to caregiving. Further examination of the heterogeneity in the impact of caregiving by employment type shows that among part-time workers, increases in caregiving hours are associated with significant reductions in labor supply, regardless of whether the care recipient is co-residing or living separately. In contrast, no such adjustment in working hours is observed among full-time workers, suggesting that their work schedules may be less flexible or constrained by contractual obligations.

Importantly, when the parent resides in a nursing home, no significant reduction in working hours is observed for either part-time or full-time workers. This suggests that institutional care may mitigate the need for labor supply adjustments, even among those with otherwise limited time flexibility.

4.3 International comparison between Japan and Europe

To examine country-specific patterns, I compared the impact of caregiving on labor supply between Japan and European countries. Following Crespo and Mira (2014), the European countries were grouped into four regions: Northern countries, Central countries, Southern countries, and Central Eastern countries. Since the SHARE data does not contain objective measures such as LTC certification, I used the parent's self-reported health status, defining it as poor and takes a dummy equals one when it is reported as 'poor' or 'fair', following Van Houtven et al. (2013). Table 6 shows that in Japan, caregiving is associated with reduced labor force participation and working hours for women. In contrast, this pattern was not observed in most European regions, except for Central Europe. Interestingly, in Europe, it was men, rather than women, who tended to reduce their likelihood of employment in response to caregiving responsibilities. As for caregiving intensity, as shown in Table 7, a 1% increase in weekly caregiving hours leads to a reduction in working hours only among women in Japan. In contrast, in Central Europe, it is men whose working hours decrease with greater caregiving intensity. In other European regions, no significant effects on working hours were observed.

4.4 Effects on Mental Health

Finally, this paper examines the impact of caregiving on mental health. While the previous analysis focused on labor supply, caregiving may also impose psychological burdens. This raises a potential endogeneity issue due to simultaneity: Are mentally healthier individuals more likely to take on caregiving roles, or does providing care to a parent affect one's mental health? Regarding the latter, it is also possible that caregiving has a positive psychological effect by giving caregivers a sense of purpose or usefulness. If caregiving cause adverse mental effect, it is also necessary to examine whether institutionalization of the care recipient alleviates the caregiver's burden. In JSTAR, depressive symptoms are assessed using the CES-D score, which is based on 20 questions regarding the respondent's mental state over the past week. These questions cover various indicators such as depressed mood, fatigue, sleep disturbances, and feelings of happiness. A higher CES-D score reflects more severe depressive symptoms. According to previous studies have pointed out similar concerns and use IV estimation, this study also use the LTC level as an instrument for caregiving variables. Table 9 shows that mental health deterioration was observed among women who provided care to co-residing parents, which was not found among men. Conversely, women's mental health showed improvement when their parents live in a nursing home.

I extend the analysis by comparing Japan with European countries to explore whether the psychological burden on caregivers exhibits unique characteristics in the Japanese context. The SHARE dataset does not contain CES-D questions; rather, mental health is assessed using the Euro-D scale, which ranges from 0 to 12, with higher values indicating greater levels of depressive symptoms. According to the international comparison results shown in Table 11, in Japan, both men and women appear to be relatively unaffected by the intensity of caregiving in terms of mental health outcomes. In contrast, in central European countries the longer caregiving hours are associated with significantly worse mental health, particularly among women. In Southern Europe, such adverse effects are more pronounced among men. These regional differences in the gendered impacts on mental health suggest that the reduction in employment due to caregiving may contribute to mental health deterioration. As shown in Tables 8 and 9, in countries where men significantly reduced their labor supply when providing care, and where longer caregiving hours were associated with further reductions in work, such declines in labor participation may partially explain the observed worsening of mental health. In Japan, however, the decline in mental health does not seem to be primarily driven by changes in labor supply. Instead, it appears to stem from cultural factors, such as co-residing with and providing care for parents-in-law, particularly among women. Although this practice has been gradually declining, there is the traditional custom in Japan whereby daughters-in-law co-reside with and care for their spouse's parents.

The results in Table 8 reveal clear gender differences. For women, engaging in caregiving is significantly associated with a worsening mental health condition, indicating that the caregiving role itself can be emotionally taxing. For men, however, it is the parent's LTC level rather than caregiving per se that is significantly associated with mental health deterioration in the OLS specification. This suggests that having a parent in worse health correlates with poorer mental well-being among men.

However, this association may partly reflect unobserved time-invariant characteristics such as family attitudes toward caregiving, pre-existing mental health tendencies, or baseline socioeconomic status that are correlated with both parental health and a son's psychological state. In the fixed effects model, the coefficient on parental care need level becomes statistically insignificant, while the coefficient on caregiving hours remains positive and significant. This finding suggests that it is not parental illness per se, but rather the increase in time spent providing care that contributes to deteriorating mental health among men. By relying on within-individual variation, the fixed effects model provides stronger support for a causal interpretation: the act of caregiving itself appears to impose psychological burdens on male caregivers, rather than simply the presence of parental health decline.

These findings suggest that both the act of caregiving and the health condition of the care recipients affect psychological well-being, but these pathways operate differently by gender.

4.5 Robustness Check

I conducted several robustness checks. First, following Oshio and Usui (2018), I conducted an analysis restricting the sample to respondents aged 60 or younger. In this subsample, caregiving was found to have little impact on labor supply. However, as shown in Appendix 1 and 2, women providing care to non-coresident parents or whose parents are in nursing homes are less likely to be employed. Regarding working hours, the reduction is observed almost exclusively among women, consistent with the findings from the main estimations.

Next estimations are conducted with several IV patterns. (IV1) is the original IV, i.e., the LTC level and its squared. (IV2) uses a binary variable that takes the value of one if the parent's LTC level is at least

“Support Level 1,” and zero if they are not certified, and (IV3) uses separate dummies for each LTC level as instruments. The results in Appendix 3 show that the whole tendency remain consistent.

Finally, to address concerns about the limited number of responses to the income questions, I conducted estimations excluding the income variable. As shown in Appendix Table 4, the results remained largely unchanged compared to the estimations that included income quantiles.

5 CONCLUSION

The number of people balancing work and caregiving is increasing. This paper contributes three key findings to the existing literature on the impact of caregiving for parents on the labor supply of adult children.

First, informal caregiving hours compete with working hours and significantly reduces the probability of employment. However, the amount of time dedicated to caregiving plays an even more substantial role. This is particularly evident in the dataset used for this study, which targets middle-aged and older individuals aged 40 to 70, many of whom continue working while providing care. The results show that a 1% increase in weekly caregiving hours leads to a 0.414% reduction in working hours, and that extending the caregiving period by two years reduces working probability by 8.4percentage points.

Second, this study applies the instrumental variable (IV) method to estimate the causal effect of caregiving on working hours, addressing the issue of endogeneity. Caregiving often takes time and tends to extend over long periods, which may lead individuals with reduced working hours to assume caregiving responsibilities. This reverse causality creates potential bias in OLS estimates. To mitigate this issue, this study uses the objectively assessed level of care needed, as determined by local governments, as an instrumental variable for caregiving. The estimation results provide robust causal evidence that informal caregiving significantly reduces both the probability of employment and the number of working hours.

Third, this study also examines the impact of a nursing home use on labor supply. The findings indicate that, even when a parent resides in a nursing home, exiting the labor force to provide care is not entirely avoidable. The estimated effect corresponds to a 31.9% reduction in weekly hours worked for women. This is likely because individuals using nursing homes often have extensive care needs, and many family caregivers may have already reduced their labor market participation.

The study also highlights important gender differences. The results reveal that caregiving responsibilities disproportionately fall on women. Women experience a 34.8% decline in weekly working hours when they provide care, and a 24.9% reduction for each additional two-year period of caregiving. For men, caregiving provision and duration were not statistically significant, but only when they provide caregiving for a co-residing parent that they reduce their working hours. This study uncovers new findings regarding the balance between work and caregiving for men, which was previously not well understood. Specifically, even men reduce their working hours by 32.6% when caring for co-habiting parents, who are most often their own parents in Japan. This trend is not observed for non-co-habiting parents, suggesting that men adjust their working hours when providing care for their own parents at home and do not reduce their working hours to provide care for non-co-habiting parents or for their spouse's parents.

These patterns were also reflected in the impact on mental health. For men, mental health deteriorated as the parent's long-term care (LTC) level increased, indicating that the worsening health of their parents contributes to psychological distress. In contrast, for women—who in Japan are more likely to care not only for their own parents but also for their spouse's parents—the act of providing care itself, rather than the parent’s LTC level, was more strongly associated with poorer mental health.

Currently, in Japan, many individuals face the “double burden” of balancing work and caregiving (Heitmueller, 2007), and this number is expected to increase in the future. The results of this study show that women, in particular, experience reduced working hours due to caregiving, potentially resulting in long-term wage penalties. While expanding public long-term care insurance benefits may offer relief, doing so poses significant financial challenges. Further research should focus on developing flexible working arrangements and caregiving leave policies to align with the needs of informal caregivers, employers, and the government.

Table 1.
Panel (A) Summary statistics of parent's variables

	Obs	Mean	Std. dev.	Min	Max
Living father (dummy)	6,915	0.23	0.42	0	1
Living mother (dummy)	6,779	0.70	0.46	0	1
Living at least one parent (dummy)	6,934	0.75	0.44	0	1
Living father-in-law (dummy)	4,840	0.26	0.44	0	1
Living mother-in-law(dummy)	4,920	0.69	0.46	0	1
Living at least one parent-in-law (dummy)	4,959	0.75	0.43	0	1
Living father					
Age (years)	1,594	85.55	5.32	67	100
Needs long-term care (dummy)	1,575	0.25	0.43	0	1
Certified LTC level	1,477	0.83	1.92	0	7
Residing in a nursing home (dummy)	1,619	0.10	0.30	0	1
Living mother					
Age (years)	4,701	85.32	6.13	66	102
Needs long-term care (dummy)	4,651	0.33	0.47	0	1
Certified LTC level	3,639	1.44	2.36	0	7
Residing in a nursing home (dummy)	4,758	0.16	0.37	0	1
Living father-in-law					
Age (years)	1,111	83.07	6.34	57	100
Needs long-term care (dummy)	1,216	0.21	0.41	0	1
Certified LTC level	1,037	0.73	1.85	0	7
Residing in a nursing home (dummy)	1,260	0.10	0.30	0	1
Living mother-in-law					
Age (years)	3,219	84.11	7.07	53	101
Needs long-term care (dummy)	3,309	0.31	0.46	0	1
Certified LTC level	2,807	1.08	2.16	0	7
Residing in a nursing home (dummy)	3,417	0.16	0.37	0	1

Panel (B) Summary statistics of certified LTC level

LTC level	Description	Freq.	Percent
Care level 5	Needs full assistance in daily living.	423	7.01
Care level 4	Needs assistance with toileting, bathing and dressing. Difficult to live without care.	352	5.83
Care level 3	Needs almost total care for walking, toileting, bathing, dressing, etc.	362	6
Care level 2	Unstable walking, etc. Needs assistance partially with toileting and bathing.	296	4.91
Care level 1	Instability in walking, etc. Needs assistance other than eating and toileting.	208	3.45
Support level 2	The recipient needs assistance with standing up and getting up. Needs support with some aspects of daily life, a cane or handrail while walking.	182	3.02
Support level 1	The recipient lives independently but needs support to prevent care. Needs support with household chores and shopping, etc.	143	2.37
Not certified LTC		4,067	67.41
Total		6,033	100

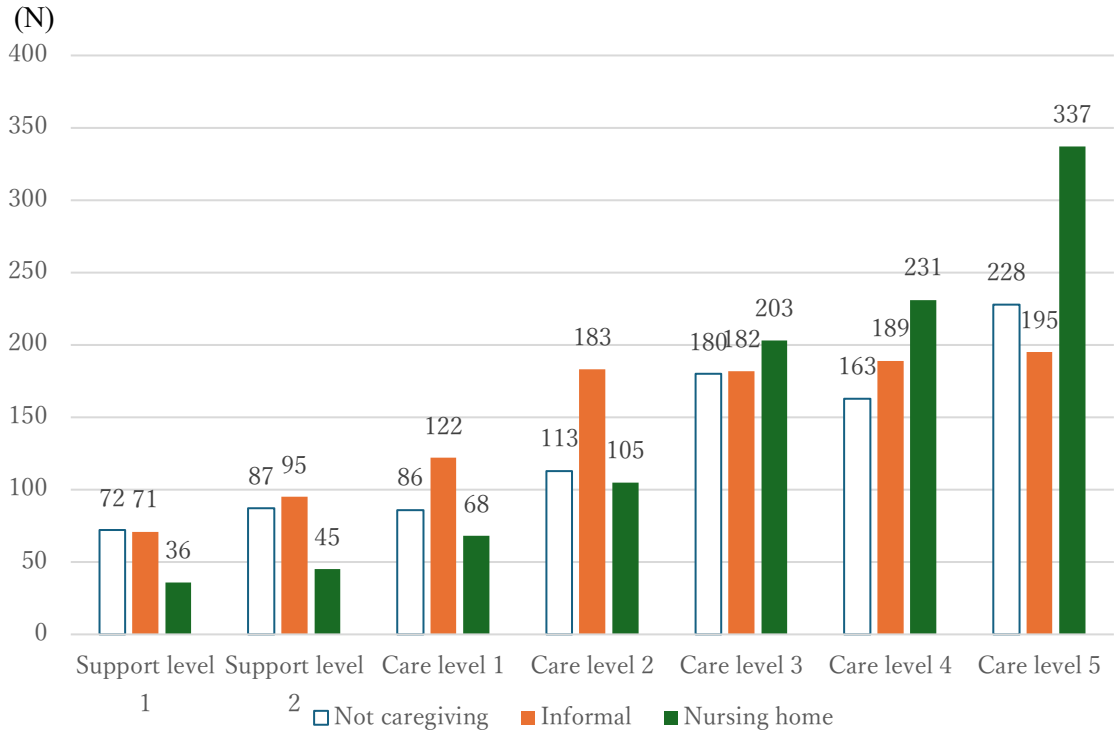
Table 1.
Panel (C) Summary statistics of caregiving variables

	Obs	Mean	Std. dev.	Min	Max
(a) Care Provision Status					
Providing care to parent (dummy)	6,938	0.20	0.40	0	1
Duration of informal care Provision (N of wave)	6,938	0.32	0.60	0	4
(b) Caregiving Context and Living Arrangement					
Providing care to co-residing parent (dummy)	2,027	0.21	0.41	0	1
Providing care to non co-residing parent (dummy)	5,728	0.17	0.37	0	1
Parent resides in a nursing home (dummy)	6,938	0.22	0.42	0	1
(c) Caregiving intensity					
Hours of caregiving per week	6,412	1.36	6.97	0	140
Hours of caregiving per day	6,938	0.66	2.99	0	24
High intensity of care (week caregiving hour>=20)	6,412	0.02	0.14	0	1
Low intensity of care (week caregiving hour<20)	6,412	0.09	0.28	0	1
Hours of caregiving per week (by direct questions in 2011 & 2013)	3,239	2.15	13.21	0	189
※**Among caregivers**					
Duration of informal care Provision (N of wave)	1,375	1.28	0.55	1	4
Hours of caregiving per week	849	10.24	16.63	0	140
Hours of caregiving per day	1,375	3.32	6.03	0	24
High intensity of care (week caregiving hour>=20)	849	0.15	0.36	0	1
Low intensity of care (week caregiving hour<20)	849	0.67	0.47	0	1
Hours of caregiving per week (by direct questions in 2011 & 2013)	753	9.26	26.18	0	189

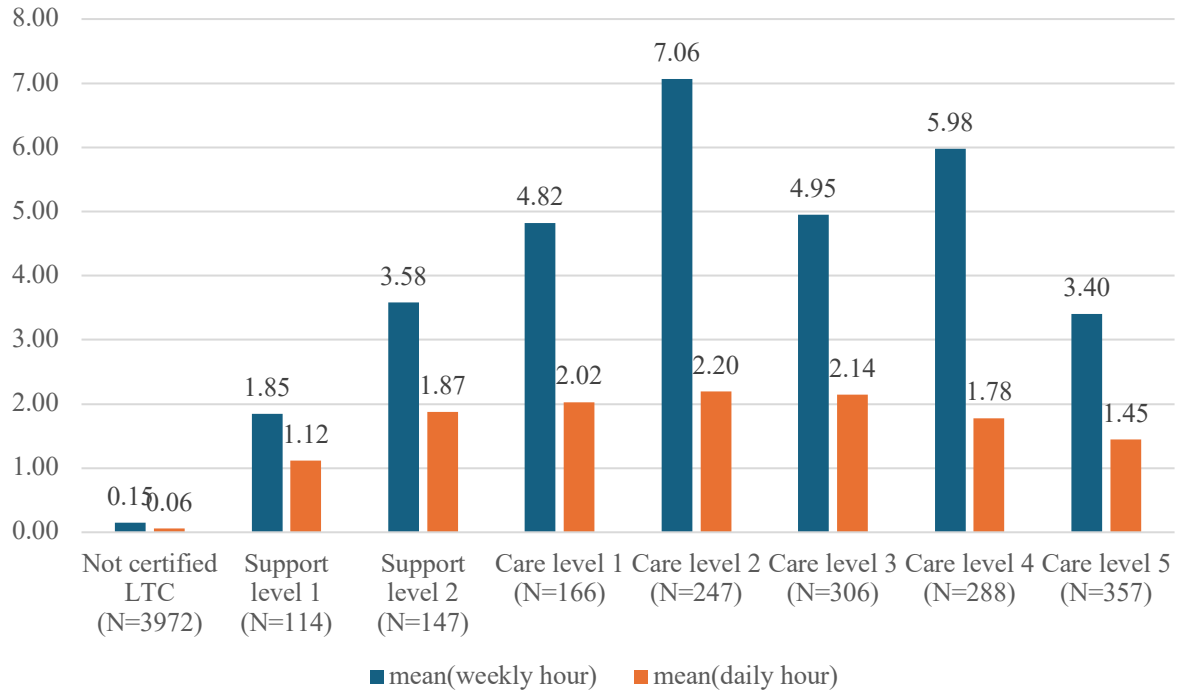
Table 1.
Panel (D) Summary statistics of explanatory variables for JSTAR and SHARE

	Not caregiver			Caregiver					
JSTAR	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.	t_stat	p_value	
Age	5389	59.97	5.91	1334	61.22	6	-6.87	0	***
Gender (1=Male, 2=Female)	5563	1.43	0.49	1375	1.56	0.5	-8.78	0	***
Married	5513	0.86	0.35	1369	0.85	0.35	0.59	0.5528	
Self-rated health (1-5)	5542	2.36	1.04	1374	2.38	1.01	-0.62	0.5337	
Number of children	5059	1.98	1.02	1237	1.93	1.01	1.37	0.1721	
Household income (quartile)	2298	2.48	1.11	596	2.42	1.12	1.07	0.2867	
Working dummy	5235	0.75	0.43	1261	0.64	0.48	7.45	0	***
Working hours per week	3641	39.45	15.05	756	35.92	16.53	5.77	0	***
SHARE	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.	t_stat	p_value	
Age	28,613	57.67	5.20	8,002	56.95	5.65	-0.94	0.35	
Gender (1=Male, 2=Female)	28,613	1.47	0.49	8,002	1.59	0.50	1.75	0.08	*
Married	28,541	0.89	0.37	7,998	0.84	0.31	-1.20	0.23	
Self-rated health (1-5)	28,509	2.87	1.02	7,999	2.65	1.06	-1.47	0.14	
Number of children	27,761	2.17	1.15	7,746	2.03	1.26	-0.78	0.44	
Household income (quartile)	26,793	2.72	1.09	7,413	2.90	1.14	1.13	0.26	
Working dummy	28,151	0.53	0.49	7,935	0.58	0.50	0.69	0.49	
Working hours per week	15,084	38.30	13.93	4,670	36.59	14.09	-0.86	0.39	

Figure 1
Panel (A) Caregiving status by parent's LTC level



Panel (B) Weekly and daily hours of caregiving by parent's LTC level



Note: N refers to the number of respondents who reported their weekly hours of caregiving. The number of respondents who provided on daily hours is nearly identical.

Panel (C) The first stage result of the estimation: informal caregiving or nursing home use

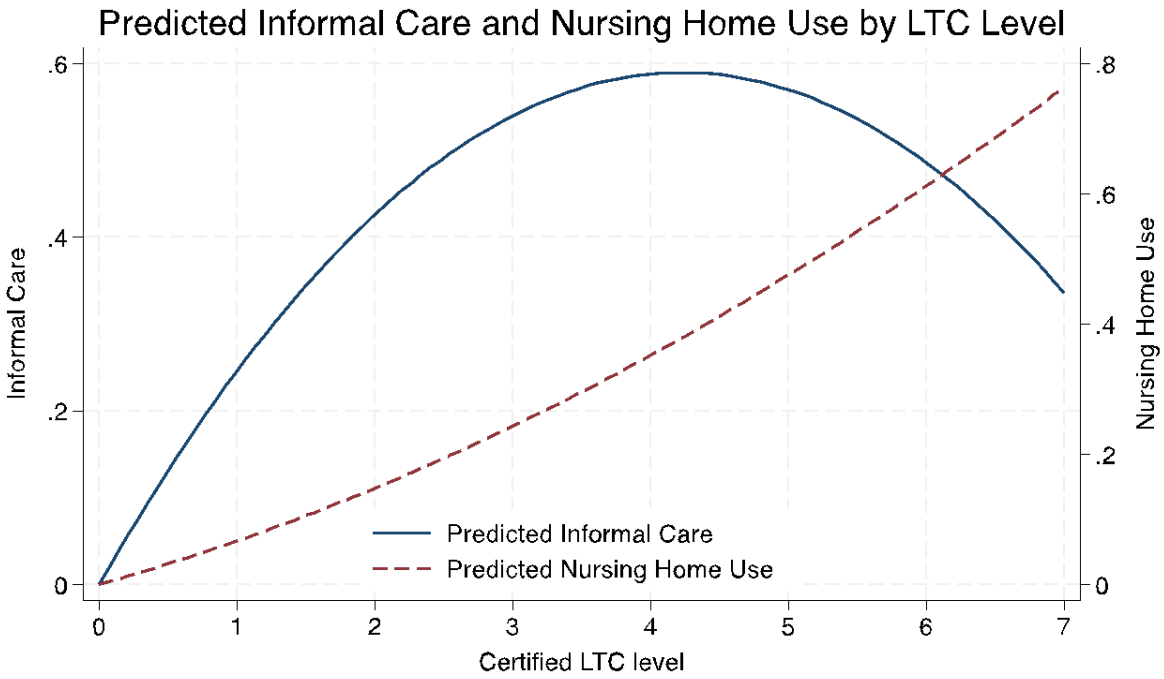


Table 2.
Panel (A) First-stage results of the effects of LTC level and its square on caregiving variables

	Providing care to parent (dummy)	Duration of informal care provision (N of wave)	Providing care to co-residing parent (dummy)	Providing care to non co-residing parent (dummy)	Log hours of caregiving per week	Log hours of caregiving per day	High intensive care (>=20 hrs)	Low intensive care (<20 hrs)	Log hours of caregiving per week (by direct questions in 2011 & 2013)	Parent resides in a nursing home (dummy)
LTC level	0.279***	0.370***	0.330***	0.204***	0.508***	0.351***	0.030***	0.207***	0.336***	0.060***
	[23.120]	[19.847]	[15.833]	[15.222]	[19.644]	[18.233]	[5.689]	[19.671]	[8.954]	[5.384]
LTC level squared	-0.033***	-0.041***	-0.040***	-0.023***	-0.063***	-0.047***	-0.003***	-0.027***	-0.039***	0.007***
	[-17.392]	[-13.822]	[-11.444]	[-10.959]	[-15.300]	[-15.280]	[-3.489]	[-15.865]	[-6.663]	[3.859]
Observations	2,393	2,393	712	1,982	2,230	2,393	2,230	2,230	1,083	2,393
R-squared	0.326	0.336	0.462	0.246	0.266	0.185	0.072	0.237	0.178	0.408

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income

Table 3 Impact of informal caregiving on employment (extensive margin)

	Dependent var. = Working dummy							
Panel (A)	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to parent (dummy)	-0.045**	-0.074	-0.062**	-0.127**				
	[-1.999]	[-1.494]	[-2.080]	[-2.117]				
Parent resides in a nursing home (dummy)					-0.037*	-0.058	-0.057*	-0.116**
					[-1.786]	[-1.417]	[-1.848]	[-2.092]
Observations	1,506	1,273	1,139	1,014	1,506	1,273	1,139	1,014
R-squared	0.354	0.346	0.196	0.185	0.354	0.347	0.195	0.184
Test of endogeneity p-value		0.5291		0.3345		0.7096		0.2633
First-stage F-value		131.52		156.48		246.76		231.11
Panel (B)	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to co-residing parent (dummy)	-0.008	0.017	-0.050	-0.062				
	[-0.198]	[0.233]	[-0.819]	[-0.624]				
Providing care to non co-residing parent (dummy)					-0.061**	-0.105	-0.066*	-0.203**
					[-2.300]	[-1.534]	[-1.937]	[-2.505]
Observations	538	450	258	233	1,171	1,022	975	874
R-squared	0.296	0.232	0.221	0.233	0.400	0.397	0.190	0.166
Test of endogeneity p-value		0.4854		0.8209		0.4907		0.0831
First-stage F-value		58.63		56.99		69.38		88.5139

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 3 Impact of informal caregiving on employment (extensive margin)*(cont.)*

Dependent var. = Working dummy												
Panel (C)	Men		Women		Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Duration of informal care provision (N of wave)	-0.020	-0.051	-0.006	-0.089**								
	[-1.343]	[-1.512]	[-0.306]	[-2.195]								
Hours of caregiving per week					-0.053	-0.004	-0.055*	-0.000				
					[-1.159]	[-0.246]	[-1.766]	[-0.024]				
Hours of caregiving per week (by direct questions in 2011 & 2013)									-0.042**	-0.060	-0.024	-0.155**
									[-2.011]	[-0.904]	[-1.075]	[-2.138]
Test of endogeneity p-value		0.3601		0.0337		0.25		0.0579		0.6785		0.0717
First-stage F-value		115.656		146.297		39.4455		87.819		19.3329		23.5718
Observations	1,506	1,273	1,139	1,014	1,190	1,404	944	1,056	732	559	550	470
R-squared	0.353	0.344	0.193	0.172	0.330	0.346	0.171	0.186	0.373	0.376	0.165	0.119

Panel (D)	Men		Women		Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Hours of caregiving per day	-0.018	-0.072	-0.008	-0.110*								
	[-0.992]	[-1.329]	[-0.380]	[-1.933]								
High intensity of care (week caregiving hour>=20)					0.257*	-1.216	0.109	-0.550*				
					[1.935]	[-1.012]	[1.462]	[-1.662]				
Low intensity of care (week caregiving hour<20)									-0.099***	-0.114	-0.088**	-0.146*
									[-2.890]	[-1.224]	[-2.236]	[-1.731]
Test of endogeneity p-value		0.277		0.0541		0.1582		0.0315		0.997		0.5742
First-stage F-value		37.5118		49.9372		2.97598		17.8495		47.0123		78.2091
Observations	1,506	1,273	1,139	1,014	1,404	1,190	1,056	944	1,404	1,190	1,056	944
R-squared	0.353	0.340	0.193	0.163	0.348	0.260	0.188	0.117	0.350	0.340	0.190	0.186

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 4 Impact of starting informal caregiving on decision of labor force exit, Logit (odds ratio)

	Dependent var. = 1 if respondent stopped working	
	men	women
Caregiving started (dummy)	1.281**	-0.374
	[2.339]	[-0.346]
Age	3.030***	0.455
	[2.815]	[0.728]
Age squared	-0.022***	-0.003
	[-2.656]	[-0.644]
Married (dummy)	0.25	-0.505
	[0.359]	[-1.183]
Number of children	0.272	-0.107
	[1.097]	[-0.402]
Self-rated health: Excellent	-0.458	-0.086
	[-0.498]	[-0.069]
Self-rated health: Very Good	-0.903	0.963
	[-0.968]	[0.916]
Self-rated health: Good	-0.174	1.048
	[-0.197]	[0.990]
Self-rated health: Fair	-1.662	
	[-1.302]	

Note: Table reports odds ratios. Control variables include education and income quantile as well..Robust z-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 5 Impact of informal caregiving on log hours of labor by *gender* (intensive margin)

	Dependent var. = Log (hours of work per week)							
Panel (A)	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to parent (dummy)	-0.048	-0.101	-0.192***	-0.429***				
	[-1.238]	[-1.061]	[-3.313]	[-3.473]				
Parent resides in a nursing home (dummy)					0.044	-0.049	-0.027	-0.319***
					[1.198]	[-0.633]	[-0.438]	[-2.916]
Observations	1,139	997	681	624	1,139	997	681	624
	0.145	0.124	0.119	0.111	0.145	0.122	0.104	0.101
Test of endogeneity p-value		0.4587		0.0241		0.2662		0.0153
First-stage F-value		86.661		82.2263		151.826		107.761
Panel (B)	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to co-residing parent (dummy)	-0.168**	-0.307*	-0.227**	-0.125				
	[-2.384]	[-1.761]	[-2.136]	[-0.744]				
Providing care to non co-residing parent (dummy)					-0.012	-0.065	-0.150**	-0.492***
					[-0.265]	[-0.489]	[-2.218]	[-2.831]
Observations	407	356	157	149	898	804	585	536
R-squared	0.157	0.096	0.182	0.189	0.146	0.133	0.122	0.095
Test of endogeneity p-value		0.1002		0.3143		0.7482		0.0227
First-stage F-value		43.4201		39.8519		40.8825		42.4719

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 5 Impact of informal caregiving on log hours of labor by *gender (cont.)*

Panel (C)	**Dependent var. = Log (hours of work per week)**											
	Men		Women		Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Duration of informal care Provision (N of wave)	-0.028	-0.133***	-0.070	-0.286***								
	[-1.008]	[-3.557]	[-1.034]	[-3.599]								
Hours of caregiving per week					-0.006	-0.068	-0.074***	-0.209***				
					[-0.184]	[-0.744]	[-2.671]	[-3.407]				
Hours of caregiving per week (in 2011 & 2013)									0.015	-0.248	-0.019	-0.414**
									[0.324]	[-1.274]	[-0.381]	[-2.217]
Observations	1,139	681	997	624	1,060	933	639	587	524	417	313	273
R-squared	0.145	0.121	0.123	0.108	0.141	0.118	0.116	0.095	0.139	0.065	0.127	
Test of endogeneity p-value		0.4413		0.0119		0.428		0.0104		0.1834		0.0345
First-stage F-value		77.3968		77.9508		24.4853		52.5815		11.0129		0.0345

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 5 Impact of informal caregiving on log hours of labor by *gender (cont.)*

Panel (D)	Men		Women		Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Hours of caregiving per day	-0.007	-0.125	-0.051	-0.350***								
	[-0.212]	[-1.121]	[-1.320]	[-3.227]								
High intensity of care (week caregiving hour>=20)					0.248	-1.301	-0.252*	-1.712***				
					[1.047]	[-0.627]	[-1.863]	[-2.966]				
Low intensity of care (week caregiving hour<20)									-0.057	-0.150	-0.185**	-0.620***
									[-0.897]	[-0.748]	[-2.316]	[-3.270]
Test of endogeneity p-value		0.2574		0.0013		0.4362		0.0033		0.5532		0.006
First-stage F-value		24.7274		34.0784		2.09508		12.3784		28.0195		42.3681
Observations	1,139	997	681	624	1,060	933	639	587	1,060	933	639	587
R-squared	0.144	0.114	0.107	0.033	0.142	0.082	0.111		0.142	0.120	0.114	0.083

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Impact of informal caregiving on log hours of labor by *employment*

Panel (A)	**Dependent var. = Log (hours of work per week)**			
	Full-time	Part-time	Full-time	Part-time
Providing care to parent (dummy)				
	-0.010	-0.372***		
	[-0.305]	[-2.878]		
Parent resides in a nursing home (dummy)			-0.017	-0.197
			[-0.623]	[-1.630]
	835	489	835	489
	0.055	0.076	0.059	0.091
Panel (B)				
	Full-time	Part-time	Full-time	Part-time
Providing care to co-residing parent (dummy)	0.015	-0.395*		
	[0.293]	[-1.897]		
Providing care to non co-residing parent (dummy)			-0.057	-0.358**
			[-1.229]	[-2.057]
Observations	269	116	696	417
R-squared	0.061	0.134	0.061	0.097

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Impact of informal caregiving on log hours of labor by *employment (cont.)*

Panel (C)	**Dependent var. = Log (hours of work per week)**					
	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Duration of informal care Provision (N of wave)	-0.009	-0.214***				
	[-0.355]	[-2.726]				
Hours of caregiving per week			-0.006	-0.198**		
			[-0.269]	[-2.564]		
Hours of caregiving per week (in 2011 & 2013)					0.005	-0.381*
					[0.071]	[-1.788]
Observations	835	489	790	446	344	225
R-squared	0.056	0.079	0.056	0.064	0.070	

Panel (D)	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Hours of caregiving per day	-0.006	-0.383***				
	[-0.202]	[-2.651]				
High intensity of care			-0.184	-1.546**		
			[-0.554]	[-2.066]		
Low intensity of care					-0.013	-0.623**
					[-0.238]	[-2.572]
Observations	835	489	790	446	790	446
R-squared	0.054		0.048		0.056	0.029

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income.Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 7 Impact of informal caregiving on working probability and hours of work- International comparison between Japan and Europe (2SLS)

Independent var. = Providing care to parent (dummy)

	(1)	(2)	(3)	(4)
	Working		Log (Hours of work)	
	Male	Female	Male	Female
Panel A: Japan				
IV estimate	-0.074	-0.127**	-0.050	-0.055*
	[-1.494]	[-2.117]	[-1.114]	[-1.806]
Observations	1,273	1,014	1,216	977
Panel B: North Europe				
IV estimate	-0.393*	-0.0263	-0.382	0.149
	[-1.772]	[-0.170]	[-1.413]	[0.660]
Observations	3,996	3,985	2,776	2,558
Panel C: Central Europe				
IV estimate	-0.763***	-0.318**	-0.649*	-0.134
	[-3.491]	[-2.293]	[-1.896]	[-0.598]
Observations	6,691	6,576	3,874	3,402
Panel D: South Europe				
IV estimate	-1.038***	-0.321	-1.127	-0.557
	[-2.705]	[-1.305]	[-1.352]	[-1.056]
Observations	3,363	3,000	1,840	979
Panel E: Central East ern Europe				
IV estimate	-2.056	-2.069	-0.0667	-0.736
	[-1.337]	[-1.011]	[-0.112]	[-1.168]
Observations	2,254	2,149	1,190	1,028

Table 8 Impact of weekly caregiving hours on working probability and hours of work- International comparison between Japan and Europe (2SLS)

Independent var. = log hours of caregiving

	(1)	(2)	(3)	(4)
	Working		Log (Hours of work)	
	Male	Female	Male	Female
Panel A: Japan				
IV estimate	-0.101	-0.429***	-0.068	-0.209***
	[-1.061]	[-3.473]	[-0.744]	[-3.407]
Observations	997	624	933	587
Panel B: North Europe				
IV estimate	-0.333*	-0.0131	-0.398	0.0870
	[-1.818]	[-0.170]	[-1.404]	[0.661]
Observations	3,996	3,985	2,776	2,558
Panel C: Central Europe				
IV estimate	-0.528***	-0.179**	-0.439**	-0.0859
	[-3.588]	[-2.334]	[-1.967]	[-0.597]
Observations	6,691	6,576	3,874	3,402
Panel D: South Europe				
IV estimate	-0.719**	-0.103	-1.017	-0.196
	[-2.386]	[-1.332]	[-1.094]	[-1.081]
Observations	3,363	3,000	1,840	979
Panel E: Central East ern Europe				
IV estimate	-1.225	-0.380**	-0.0967	-0.312
	[-1.642]	[-2.034]	[-0.112]	[-1.305]
Observations	2,254	2,149	1,190	1,028

Table 9 Impact of Informal Caregiving on Mental Health (CESD20) *by gender* (2SLS)

	Dependent var. = CESD 20							
	Men	Women	Men	Women	Men	Women	Men	Women
Providing care to parent (dummy)	1.073	0.126						
	[1.412]	[0.153]						
Parent resides in a nursing home (dummy)			1.04	-1.399*				
			[1.542]	[-1.867]				
Providing care to co-residing parent (dummy)					0.581	2.715*		
					[0.602]	[1.954]		
Providing care to non co-residing parent (dummy)							1.543	-0.218
							[1.332]	[-0.191]
Observations	1290	1057	1290	1057	452	246	1033	909
R-squared	0.091	0.15	0.094	0.151	0.074	0.081	0.096	0.168

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 10 Impact of Informal Caregiving on Mental Health (CESD20) *by employment* (2SLS)

	Dependent var. = CESD 20											
	full-time	part-time	full-time	part-time	full-time	part-time	full-time	part-time	full-time	part-time	full-time	part-time
Duration of informal care Provision (N of wave)	1.686*	0.658										
	[1.879]	[0.923]										
Hours of caregiving per week			1.191*	0.898								
			[1.810]	[1.363]								
Hours of caregiving per week (by direct questions in 2011 & 2013)					2.214	0.412						
					[1.041]	[0.209]						
Hours of caregiving per day							1.753*	1.325				
							[1.761]	[1.146]				
High intensity of care (week caregiving hour>=20)									14.400	4.637		
									[1.506]	[0.689]		
Low intensity of care (week caregiving hour<20)											3.075*	3.180
											[1.801]	[1.601]
Observations	849	504	804	461	354	233	849	504	804	461	804	461
R-squared	0.057	0.116	0.083	0.129	0.046	0.156	0.049	0.102		0.112	0.082	0.123

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Table 11. Impact of Informal Caregiving Intensity on Mental Health (CESD20 and Euro-D) - International comparison between Japan and Europe *(*2SLS)

	CESD20		Euro-D							
	Japan		North Europe		Central Europe		South Europe		Central East ern Europe	
	male	female	male	female	male	female	male	female	male	female
Providing care to parent (dummy)	1.073	0.126	0.249	-0.135	0.993	3.189***	4.068***	1.465	-0.249	6.209
	[1.412]	[0.153]	[0.310]	[-0.215]	[1.304]	[4.524]	[2.714]	[1.191]	[-0.074]	[0.901]
	1,290	1,057	3,965	3,987	6,666	6,588	3,364	3,009	2,249	2,169
Hours of caregiving per week	0.707	0.260	0.213	-0.069	0.693	1.881***	2.824**	0.489	-0.145	1.233
	[1.184]	[0.631]	[0.310]	[-0.215]	[1.302]	[4.497]	[2.406]	[1.200]	[-0.075]	[1.295]
	1,209	982	3,965	3,987	6,666	6,588	3,364	3,009	2,249	2,169
High intensity of care (week caregiving hour>=20)	13.375	-1.679	10.147	2.409	6.123	9.634***	34.571	1.855	-3.897	1.693
	[0.961]	[-0.428]	[0.626]	[0.360]	[0.744]	[2.865]	[1.061]	[0.940]	[-0.204]	[0.441]
	1,209	982	2,573	2,605	3,744	3,699	2,374	2,084	728	720
Low intensity of care (week caregiving hour<20)	1.731	1.377	0.760	0.255	1.242	3.712***	4.479**	1.924	5.912	3.720
	[1.333]	[1.170]	[0.673]	[0.364]	[0.762]	[2.783]	[2.292]	[0.907]	[0.143]	[0.370]
Observations	1,209	982	2,573	2,605	3,744	3,699	2,374	2,084	728	720

Notes: For both CESD20 and Euro-D scales, higher score reflect worse mental health. Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets
*** p<0.01, ** p<0.05, * p<0.1.

Appendix 1 Robustness check: Effect of Informal Caregiving on Employment *by gender, age under 60* (2SLS)

	Dependent var. = Working dummy									
	Providing care to parent (dummy)		Parent resides in a nursing home (dummy)		Providing care to co-residing parent (dummy)		Providing care to non co-residing parent (dummy)		Provided care to parent (number of waves)	
	male	female	male	female	male	female	male	female	male	female
Coefficient	-0.044	-0.098	-0.042	-0.141**	-0.078	0.038	-0.023	-0.238**	-0.033	-0.072
	[-1.185]	[-1.334]	[-1.514]	[-1.989]	[-1.205]	[0.357]	[-0.525]	[-2.103]	[-1.117]	[-1.327]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	727	658	727	658	281	162	591	575	727	658
R-squared	0.156	0.096	0.163	0.095	0.140	0.241	0.193	0.065	0.158	0.090

	Log hours of caregiving per week		Log hours of caregiving per day		High intensive care (>=20 hrs)		Low intensive care (<20 hrs)		Log hours of caregiving per week (by direct questions in 2011 & 2013)	
	male	female	male	female	male	female	male	female	male	female
Coefficient	-0.041	-0.045	-0.036	-0.057	-0.815	-0.530	-0.102	-0.126	0.000	-0.197
	[-1.203]	[-1.234]	[-1.116]	[-0.959]	[-1.088]	[-1.356]	[-1.233]	[-1.194]	[0.012]	[-1.537]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	687	611	727	658	687	611	687	611	268	270
R-squared	0.154	0.086	0.157	0.095	0.017	0.050	0.153	0.089	0.157	0.035

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Appendix 2 Robustness check: Effect of Informal Caregiving on Log Hours of Work *by gender, age under 60* (2SLS)

	(a) Care Provision Status				(b) Caregiving Context and Living Arrangement					
	Providing care to parent (dummy)		Provided care to parent (number of waves)		Providing care to co-residing parent (dummy)		Providing care to non co-residing parent (dummy)		Parent resides in a nursing home (dummy)	
	male	female	male	female	male	female	male	female	male	female
Coefficient	-0.104	-0.295**	-0.088	-0.221**	-0.257	0.075	-0.208	-0.402**	-0.065	-0.230*
	[-1.028]	[-2.396]	[-1.013]	[-2.418]	[-1.447]	[0.456]	[-1.227]	[-2.112]	[-0.892]	[-1.944]
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	656	457	656	457	250	115	538	393	656	457
R-squared	0.062	0.144	0.062	0.127	0.092	0.177	0.074	0.139	0.057	0.136

	(c) Caregiving Intensity			
	Log hours of caregiving per week		Log hours of caregiving per day	
	male	female	male	female
Coefficient	-0.205*	-0.052	-0.098	-0.239**
	[-1.719]	[-0.755]	[-0.984]	[-2.205]
Control	Yes	Yes	Yes	Yes
Observations	317	189	656	457
R-squared	0.064	0.171	0.046	0.088

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Appendix 3 Robustness check: Several IVs: (IV1) =LTC level and LTC squared, (IV2)= 1 if LTC level > =1, 0 if LTC level =0, (IV3)= each LTC level dummy

	Dependent var. = Log (hours of work per week)										
	IV1	IV2	IV3	IV1	IV2	IV3	IV1	IV2	IV3	IV1	IV2
Providing care to parent (dummy)	-0.429***	-0.410***	-0.291***								
	[-3.473]	[-3.277]	[-2.645]								
Parent resides in a nursing home (dummy)				-0.319***	-0.442***	-0.250**					
				[-2.916]	[-3.203]	[-2.164]					
Providing care to co-residing parent (dummy)							-0.125	-0.125	-0.082		
							[-0.744]	[-0.738]	[-0.613]		
Providing care to non co-residing parent (dummy)										-0.492***	-0.480***
										[-2.831]	[-2.799]
Observations	624	681	457	624	681	457	149	157	115	536	585
R-squared	0.111	0.100	0.145	0.101	0.041	0.135	0.189	0.177	0.210	0.095	0.085

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individ
statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

	Dependent var. = Log (hours of work per week)										
	IV1	IV2	IV3	IV1	IV2	IV3	IV1	IV2	IV3	IV1	IV2
Duration of informal care Provision (N of wave)	-0.286***	-0.264***	-0.227***								
	[-3.599]	[-3.317]	[-2.675]								
Hours of caregiving per week				-0.209***	-0.210***	-0.103*					
				[-3.407]	[-3.329]	[-1.892]					
Hours of caregiving per week (by direct questions in 2011 & 2013)							-0.414**	-0.206	-0.246		
							[-2.217]	[-1.200]	[-1.401]		
Hours of caregiving per day										-0.350***	-0.327***
										[-3.227]	[-3.095]
Observations	624	681	457	587	639	429	273	313	177	624	681
R-squared	0.108	0.105	0.126	0.095	0.081	0.145		0.088	0.224	0.033	0.037

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individ
statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

	IV1	IV2	IV3	IV1	IV2	IV3
High intensity of care (week caregiving hour>=20)	-1.712***	-1.864***	-0.997*			
	[-2.966]	[-2.971]	[-1.647]			
Low intensity of care (week caregiving hour<20)				-0.620***	-0.651***	-0.326**
				[-3.270]	[-3.245]	[-2.033]
Observations	587	639	429	587	639	429
R-squared			0.107	0.083	0.065	0.127

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Appendix 4 Robustness check Control variables include income or exclude income

Panel (A) **Dependent var. = Working dummy**

	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to parent (dummy)	-0.045**	-0.073	-0.050*	-0.117**				
	[-2.006]	[-1.484]	[-1.727]	[-2.016]				
Parent resides in a nursing home (dummy)					-0.034*	-0.062	-0.053*	-0.116**
					[-1.673]	[-1.509]	[-1.766]	[-2.119]
	1,539	1,300	1,184	1,054	1,539	1,300	1,184	1,054
	0.348	0.340	0.188	0.175	0.348	0.341	0.188	0.175

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, education, household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

Panel (B) Without income

	Men		Women		Men		Women	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Providing care to parent (dummy)	-0.030*	-0.024	-0.067***	-0.099**				
	[-1.956]	[-0.665]	[-3.206]	[-2.460]				
Parent resides in a nursing home (dummy)					-0.027*	-0.037	-0.062***	-0.108***
					[-1.906]	[-1.234]	[-2.937]	[-2.745]
Observations	3,265	2,783	2,596	2,294	3,265	2,783	2,596	2,294
R-squared	0.278	0.265	0.141	0.138	0.278	0.265	0.140	0.137

Notes: Each column reports coefficients from a separate regression. Other socio-economics variables include age, age squared, marital status, number of children, not household income. Standard errors clustered at the individual level. t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1.

References

Bauer, J. M., & Sousa-Poza, A. (2015). Impacts of informal caregiving on caregiver employment, health, and family. *Journal of population Ageing*, *8*, 113-145.

Bolin, K., Lindgren, B., Lundborg, P., 2008. Your next of kin or your own career? Caring and working among the 50+of Europe. *Journal of Health Economic*s, 27 (3), 718–738.

Bonsang, E. (2009). Does informal care from children to their elderly parents substitute for formal care in Europe?. *Journal of health economics*, *28*(1), 143-154.

Brenna, E., & Di Novi, C. (2016). Is caring for older parents detrimental to women's mental health? The role of the European North–South gradient. *Review of Economics of the Household*, *14*, 745-778.

Coe, N. B., & Van Houtven, C. H. (2009). Caring for mom and neglecting yourself? The health effects of caring for an elderly parent. *Health Economics*, *18*(9), 991-1010.

Van Houtven, C. H., Coe, N. B., & Konetzka, R. T. (2015). Family Structure and Long-Term Care Insurance Purchase. *Health Economics*, *24*, 58-73.

Crespo, L., Mira, P., 2014. Caregiving to elderly parents and employment status of European mature women. *Review of Economics and Statistics,* 96 (4), 693–709.

Do, Y. K., Norton, E. C., Stearns, S. C., & Van Houtven, C. H. (2015). Informal care and caregiver's health. *Health Economics*, *24*(2), 224-237.

Fuino, M., & Wagner, J. (2020). Duration of long-term care: socio-economic factors, type of care interactions and evolution. *Insurance: Mathematics and Economics*, *90*, 151-168.

Geerts, J., & Van den Bosch, K. (2012). Transitions in formal and informal care utilisation amongst older Europeans: the impact of national contexts. *European Journal of Ageing*, *9*, 27-37..

Heitmueller, A., 2007. The chicken or the egg? Endogeneity in labour market participation of informal carers in England. *Journal of Health Economics*. 26 (3), 536–559.

Hiel, L., Beenackers, M. A., Renders, C. M., Robroek, S. J., Burdorf, A., & Croezen, S. (2015). Providing personal informal care to older European adults: should we care about the caregivers' health?. *Preventive medicine*, *70*, 64-68.

Ichimura, H., Hashimoto, H., & Shimizutani, S. (2009). JSTAR First Results 2009 Report. RIETI Discussion Paper Series 09-E-047.

Kaschowitz, J., & Brandt, M. (2017). Health effects of informal caregiving across Europe: A longitudinal approach. *Social Science & Medicine*, *173*, 72-80.

Kondo, A. (2017). Availability of long-term care facilities and middle-aged people's labor supply in Japan. *Asian Economic Policy Review*, 12(1), 95-112.

Kumagai, N. (2017). Distinct impacts of high intensity caregiving on caregivers' mental health and continuation of caregiving. *Health Economics Review*, *7*, 1-14.

Life Insurance Cultural Center (2021), National Survey on Life Insurance.

Lilly, M. B., Laporte, A., & Coyte, P. C. (2007). Labor market work and home care's unpaid caregivers: a systematic review of labor force participation rates, predictors of labor market withdrawal, and hours of work. *The Milbank Quarterly*, *85*(4), 641-690.

Ministry of Internal Affairs and Communications, Japan, Statics Bureau (2022) Employment Status Survey.

Ministry of Internal Affairs and Communications, Japan, Statics Bureau (2023) Labor Force Survey.

Oshio, T. (2014). The association between involvement in family caregiving and mental health among middle-aged adults in Japan. *Social Science & Medicine*, *115*, 121-129.

Oshio, T. (2015). How is an informal caregiver's psychological distress associated with prolonged caregiving? Evidence from a six-wave panel survey in Japan. *Quality of Life Research*, *24*, 2907-2915.

Oshio, T., & Usui, E. (2018). How does informal caregiving affect daughters' employment and mental health in Japan?. *Journal of the Japanese and International Economies*, *49*, 1-7.

Pinquart, M., & Sörensen, S. (2003). Associations of stressors and uplifts of caregiving with caregiver burden and depressive mood: a meta-analysis. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *58*(2), P112-P128.

Pinquart, M., & Sörensen, S. (2007). Correlates of physical health of informal caregivers: a meta-analysis. *The journals of Gerontology series B: Psychological Sciences and Social Sciences*, *62*(2), P126-P137.

Schmitz, H., & Westphal, M. (2015). Short-and medium-term effects of informal care provision on female caregivers' health. *Journal of Health Economics*, *42*, 174-185.

Simard-Duplain, G. (2022). Heterogeneity in informal care intensity and its impact on employment. *Journal of Health Economics*, *86*, 102647.

United Nations. Department of Economic and Social Affairs, Population Division (2022). *United Nations Database on the Households and Living Arrangements of Older Persons 2022*. DESA/POP/2022/DC/No.7.

Van den Berg, B., & Ferrer-i-Carbonell, A. (2007). Monetary valuation of informal care: the well-being valuation method. *Health economics*, 16(11), 1227-1244.

Van den Berg, B., Fiebig, D. G., & Hall, J. (2014). Well-being losses due to caregiving. *Journal of health economics*, *35*, 123-131.