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

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Abstract

As the number of individuals balancing caregiving and employment rises in Japan, this study investigates the impact of informal caregiving for parents on the labor supply of middle-aged children using the Japanese Study of Aging and Retirement (JSTAR) panel data. To address endogeneity, instrumental variable estimation is applied, using the level of parents' certification of long-term care needs as instruments. The findings reveal that informal caregiving significantly reduces working hours, particularly for women and part-time workers, with a 1% increase in caregiving hours leading to a 0.15% reduction in working hours. Although part-time workers experience larger reductions, caregiving also affects some men and full-time workers. While the use of nursing homes alleviates caregiving burdens, women continue to experience notable reductions in working hours. These findings underscore the pressing need for flexible work arrangements and care leave policies to support working caregivers.

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1. INTRODUCTION

In Japan, the number of elderly individuals requiring nursing care is expected to increase significantly as the entire baby boomer generation reaches 75 years of age around 2025. According to the 2022 Employment Status Survey from Ministry of Internal Affairs and Communications, 3.64 million individuals provide informal care while also working, and 58.0% of informal caregivers hold a job. These individuals are referred to as business caregivers. Furthermore, approximately 106,000 individuals leave their jobs each year to care for their parents or others, known as care leavers. The number of those business caregivers and care leavers are projected to rise, presenting considerable challenges for Japan’s labor market, which increasingly depends on the participation of women and older adults to counteract the declining population. Thus, it is crucial to investigate the impact of informal caregiving on caregivers' work to prevent economic losses such as caregiver turnover and lost productivity. Due to the growing number of business caregivers and care leavers as the number of older adults increase, the issue of balancing work and caregiving responsibilities becoming a pressing policy concern.

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Despite the riding number of business caregivers balancing employment and caregiving, the extent to which caregiving competes with working hours remains unclear. It is also uncertain whether this effect disproportionately impacts women and part-time workers. As increasing the number of family caregivers, Japanese government started the public long-term care (LTC) insurance system in 2000, designed to shift caregiving responsibilities from families to society. The LTC insurance system provides low-cost access to care services and nursing homes. While this system potentially reduces the burden on family caregivers and help 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 has 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, informal caregiving only reduces the probability of female employment by 3.2% (Oshio and Usui, 2018). Similarly, studies from the United States and Europe show limited evidence that caregiving leads to significant reductions in employment (Bauer and Sousa-Poza, 2015; Crespo and Mira, 2014; Lilly et al., 2007). However, the extent of the impact appears to vary depending on factors such as the identity of the care recipient, i.e., parent, parent-in-law, spouse, etc. (Bolin et al., 2008a; Geerts and Van den Bosch, 2011; Do et al., 2015), the intensity of caregiving in terms of hours (Kumagai, 2017; Kaschowitz and Brandt, 2017), and the duration over which caregiving responsibilities lasts (Oshio, 2015; Fuino and Wagner, 2020; Simard-Duplain, 2022).

This study focuses on three critical aspects of the relationship between caregiving and labor supply. The first aspect addresses the increasing competition between caregiving and working hours as more adult children provide care for aging parents while remaining in the workforce. Historically, caregiving responsibilities were predominantly undertaken by women and part-time workers, whose working hours were relatively short. However, recent data of 2023 Employment Status Survey from Ministry of Internal Affairs and Communications indicate that the number of employed women in Japan has reached a record high, and the number of people 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, examining the likelihood of employment (Oshio and Usui, 2018), while little research has been employed on the intensive margin, such as the effect of caregiving on the number of hours worked. The second aspect concerns the issue of endogeneity in estimating the causal effect of caregiving on labor supply. The relationship between caregiving and labor supply is bidirectional, as the decision to provide informal care may itself be influenced by 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 many of previous literature use an instrumental variable (IV) approach or propensity score matching method. In this study, I employ an IV estimation using parent's long-term care certification level. This certification level, which is determined by local government based on objective medical assessment, serves as an exogenous indicator of caregiving need. Following prior studies (Coe, et al., 2009; Oshio and Usui, 2018; Heitmueller., 2007), the certification level serves as an exogenous indicator or parent's health and caregiving need. This measure objectively reflects the necessity for caregiving,

independent of the caregiver's labor market, and influences labor supply solely through the provision of care to the parent. It isolates the causal effect of caregiving, minimizing the bias of estimation or reverse causality. The third aspect emphasizes the long-term care natures. It is essential to recognize that caregiving often extends over long periods. Unlike childcare and other forms of caregiving, elder care is characterized by its unpredictable and often extended duration. According to the 2021 National Survey on Life Insurance conducted by the Life Insurance Cultural Center of Japan, the average length of nursing care among current caregivers is 61.1 months. Additionally, 17.6% of respondents have been providing nursing care for more than 10 years, and 31.5% for 4 to 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 provision at a single point in time, few studies have accounted for the impact of caregiving dration (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 investigate the effect of caregiving for parents on labor supply. By employing three waves of panel data from 2007, 2009, and 2011, this study captures caregiving periods of up to six years, allowing for a comprehensive analysis of the long-term effects of caregiving on labor outcomes. Additionally, since the long-term care certification level determine information on caregiving hours and the use of nursing homes, this study evaluate how family caregiving decisions, including the utilization of institutional care, affect labor supply.

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. Furthermore, by looking at the different effects depending on the employment status, this study investigates whether full-time workers experience similar labor supply reduction as part-time workers.

This study finds that informal caregiving significantly reduces working hours, particularly for women and part-time workers. A 1% increase in caregiving hours is associated with a 0.12% to 0.15% decline in working hours, underscoring the time-intensive nature of caregiving. Part-time workers experience a greater reduction in working hours compared to full-time workers, but caregiving also leads to a statistically significant reduction in working hours for partly male and full-time employees, suggesting that balancing work and caregiving is a challenge across genders and employment types. The use of nursing homes does not significantly reduce children's working hours, suggesting that institutional care alleviates some of the direct caregiving burden. However, for women, the use of nursing home has still significant effect, but it lessens the caregiving burden compared to informal care at home.

The remainder of this paper is organized as follows. Section 2 reviews the literature on the relationship between labor and informal caregiving and introduce the background in Japanese context. Section 3 provides details about the data and descriptive statistics. Section 4 presents the empirical model and section 5 presents the results. Section 6 discuss the results and concludes.

2. BACKGROUND

2.1 Literature

There is a vast body of literature on the work of family caregivers. As adult children, particularly females, are the most common type of informal care providers, most studies have focused on the effects of the relationship between daughters and parents or daughters-in-law and parents (Do et al., 2015). The effects may differ for child caregivers who provides informal care to parents compared to spouse caregivers who provides caregiving to his/her spouse in terms of differences in age, health, and time constraints. Adult child caregivers are mostly middle-age and older and often face the challenge of balancing their careers and families since they are working and/or they raise their children at the same time. Several studies also considers whether they live together or separately, how closely they live together with their parents, and the family's ties. For example, Brenna and Di Novi (2014) focused on the differences in values toward family caregiving and caregiving systems across European countries and showed that southern Europe had a significant negative impact of informal care provision on the mental health of daughters, but northern Europe did not. In Japan, the proportion of individuals co-residing with their parents is higher than in Western countries (UN), necessitating an examination of the differences in the effects of caregiving between co-residing and non-coresiding parents. However, to the best of my knowledge, no existing research has addressed this issue.

Recent studies have approached the potential endogeneity problem of informal caregiving using the instrumental variables technique. To estimate the causal effect of informal caregiving on the caregiver's health, some studies have used parental health (Pingquart and Sorensen, 2003, 2007; Coe and Van Houtven, 2009, 2015; Crespo and Mira, 2014; Do et al., 2015) and information on number of the siblings (Coe and Van Houtven, 2009) as instrumental variables. Some studies have used the variables of geographical distance from children number as instruments (Charles and Sevak, 2005; Stern, 1995; Bonsang, 2009). However, it might be the case that the children choose to move near their parents when their parents' health deteriorates. Another method for estimating the causal effects of informal caregiving is the matching method (Brenna and Di Novi, 2016; Schmitz and Westphal, 2015). This method requires satisfaction of the monotone assumption of instrumental variables, but it does not always have to be valid. In this study, the instrumental variable approach is used, with caregiving involvement as the treatment and the objectively measured long-term care need level of the parent as the instrumental variable. If the parent's health deteriorates, the likelihood of providing informal care may increase. However, if formal care, including a nursing home care, is utilized, the likelihood of informal care provision may decrease (Bonsang, 2009). To discuss this point, the use of nursing homes was also included in the analysis.

2.2 Public Long-term Care system in Japan

In Japan, a public long-term care insurance system was introduced in 2020. The long-term care insurance provides several support programs for individuals who need care. Under this system, long-term care services are provided with a 30% co-payment by the recipient. To receive long-term insurance benefits in Japan, individuals must obtain a certification of care-needs from the municipality in which they reside. The

long-term care need assesses whether a person requires nursing care or support, and if so, to what degree. The certification of long-term care needs in Japan refers to the assessment process used in the country's long-term care insurance system. This certification is connected to the amount of care service benefits, the criteria are set objectively and uniformly across the country. Municipality evaluates the level of care required by disabled individuals aged 40-64 who required care due to age-related diseases or elderly aged over 65 according to the following process. First, an application for the long-term care insurance system is filed with the municipality in residence. The municipality sends an investigation official to the home to interview the patient and family members. Then, the doctor is asked to submit a written opinion to confirm the physical and mental condition of the patient. The municipality then decides on the level of their long-term care needs. The results are divided into seven levels, from needed support level 1 and 2 (level 1 is lower requiring support), to needed long-term care level 1 to 5 (level 5 requiring nursing care the most), and not applicable. The assessment takes into account various factors, including physical functions, activities of daily living, cognitive abilities and other relevant aspects. Based on the level, the municipality determines the appropriate level of care and support services provided for each elderly under the long-term care security system.

3. DATA

The analysis in this paper is based on data from Japanese Study of Aging and Retirement (JSTAR)[2], which is a survey of middle-age and elderly people aged 50 or older in Japan. Individuals are surveyed, and the number of respondents are 3,744 in 2007, 4,117 in 2009, and 5,122 in 2011 respectively. 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. The analysis and results using SHARE by, for example, Bongsang(2009) can also be compared in this paper.

JSTAR is the one of the most appropriate datasets in Japan to look at the impacts of informal care on family caregivers' work because the respondents are primarily middle-aged and older adults of caregiving age. Neither parents nor parents-in-law are still alive are excluded in this study. It includes information on the provision of family care (time, frequency, to whom), whether the respondents live with or separately from his/her parents or parents-in-law[3], and the information on the level of care required by the parents and parents-in-law as well as the health and socio-economic variables of the respondents. The levels of care required under Japan's public long-term care insurance system are indicators of the health of

[2] JSTAR is conducted by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University and the University of Tokyo. The first survey carried out in five cities in 2007, second 2009 survey includes a follow-up survey of the respondents to the 2007 survey and an initial survey of respondents in two additional municipalities, and 2011 survey includes a follow-up surveys of these previous two surveys plus an initial survey of respondents in three additional municipalities. The number of respondents from the five cities participating since the first (2007), second (2009), and third (2011) sessions were 4163, 3083, and 2480, respectively. The number of respondents from the two cities that have participated in the survey since the second survey (2009) was 1567 for the second survey and 1097 for the third survey (2011). The number of respondents from the four cities that have participated in the survey since the third survey (2011) was 2184.

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

elderly individuals, officially assessed through a public evaluation process as mentioned in the section 2.2. While Oshio and Usui (2018) focused their analysis on respondents who were Japanese women aged 50-59, this study includes both men and women in the analysis because this study looks at family caregivers who are working or have left the profession due to caregiving. Subsequent analysis will also look at any differences between men and women. The analysis is also restricted to those under the age of 61 in the robustness check. The reason for this is the same as in Oshio and Usui (2018): labor supply is affected by pensions and retirement. In Japan, many companies stipulate a mandatory retirement age between 60 and 65, when public pension payments start. Therefore, to eliminate reasons other than family caregiving that may affect labor supply, I identify the impact of family caregiving and its effect on labor supply for those aged 60 and younger.

3.1 Caregiving variables

The main variables on caregiving in this study are summarized in Table 1. I restrict adult children who have at least one living parent or parent-in-low. I also consider individuals as caregivers when they provided informal care to their parent or parent-in-low, not their spouses neither other family members. Regarding caregiving, JSTAR asks whether or not they provide informal caregiving, whether they provide care to their father, mother, father-in-law, and mother-in-law respectively, and if so, how much time they spend caring for them. The following questions were used to address hours of care needs and use of care facilities.

"Does your father[4] *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."*

Options: 1. At home and in need of care (about X hours a day), 2. In an institution, 3. Not in need of care, 4. Don't know, 5. Refused to answer.

If the respondent chooses *2. In an institution* of these options, the variable of nursing home use is taken as 1, otherwise 0. Regarding caregiving time, there are two ways of measuring. (i) in-home interviews using a computer, which questionnaire is shown above, and (ii) in-home retention surveys (self-completion using a questionnaire). From the question in (i) the computer-based in-home interview survey, respondents are asked how many hours of care does your father need[5] as in above option *1. At home and in need of care (about X hours a day)*. This 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. However, 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. However, the data does not tell us whether or not public LTC home care services are used. The other

[4] There are questions for mother, father-in-law, mother-in-law as well.

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

survey, (ii) the home-visit retention survey, 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 weekday care hours times five days plus weekend care hours times two days. These caregiving hours per day and per week are logged-transformed.

Taking advantage of the characteristics of panel data, I also analyze 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 a maximum of three times. Using the characteristics of the panel data, the duration of caregiving is defined as 6 years if the person has provided care for three 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 3 in 2011, among 1,992 respondents, there are 877 respondents who have never involved in informal caregiving, 955 people have involved in for two years, 131 people involved in four years, and 29 involved in six years. However, for the sample surveyed starting in 2011, 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 2009 or after the 2011 survey. Those who started the study at 3rd wave are more likely to continue caring after 3rd wave, and if they are caring at 3rd wave, the duration of care is considered to be two years, so the effect of the one term, i.e., two years, will be stronger. Therefore, it should be recognized that the estimated impact of caregiving duration represents a lower bound.

3.2 Instrumental variables

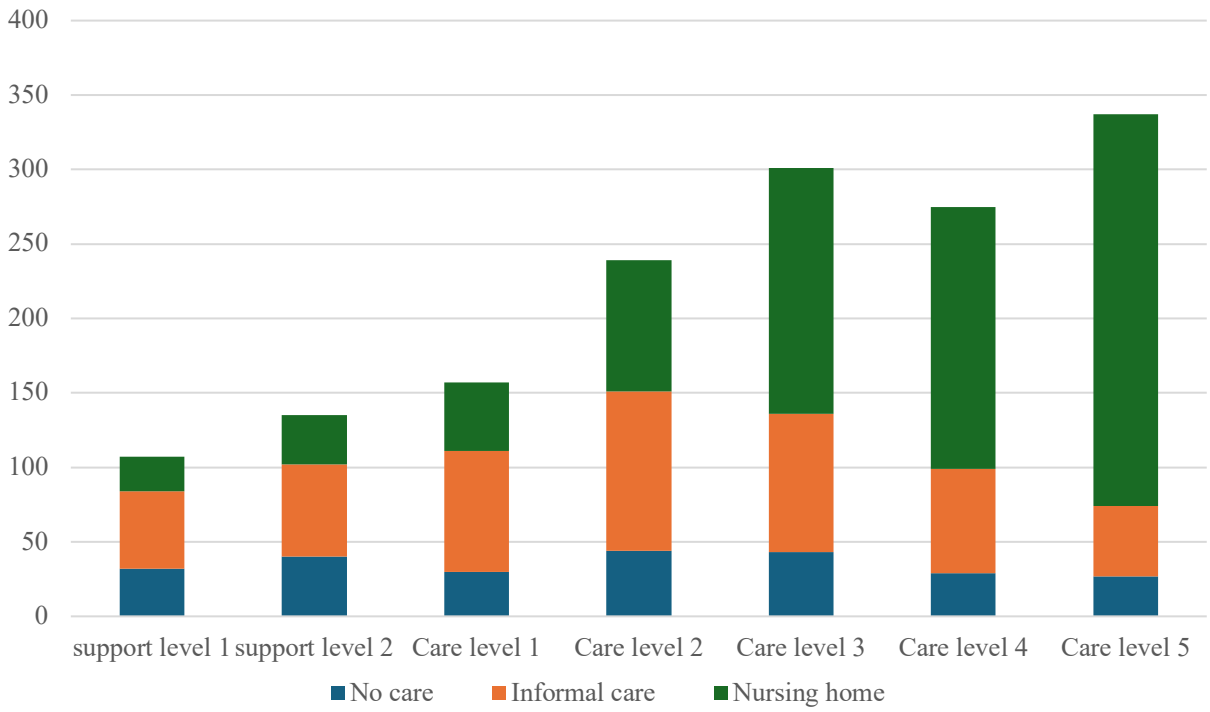
There are endogeneity problems of caregiving decisions. Those who decide to provide informal care, they tend to reduce their labor supply or working hours. Simultaneously, those who work less hours of work tend to provide informal caregiving and may not use the nursing home for their parents. In order 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 long-term care (LTC) level is possible candidates. Since the LTC level is objective score of parent’s health status, there has significant impact on the caregiving needs, but it does not directly affect children’s labor supply.

There are seven LTC levels. 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 need become more severe, more the probability of using nursing home care instead of informal care at home. Figure1 categorizes the data into informal care, nursing home use, and no care provision, based on the LTC level of the parents. The highest LTC level between one's own parents and the spouse's parents is used. In other words, this table shows the relationship between the LTC level of the parent with the highest care needs and the type of care provided. The Appendix Figure includes results that separately analyze one's own parents and the spouse's parents.

The number of people providing informal care increased as the parent's LTC level increased but tended to decrease after level 2. It displays the U-shape relationship between informal caregiving and the LTC level. On the other hand, the number of users of nursing homes increases with each level of care required. 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 parent's LTC level is also included as the instrumental variable.

Figure 1 Categorization of care provision based on LTC level of parents: Informal care, nursing home use, and no care provision



3.3 Descriptive results

In Table 1, caregiving-related variables are summarized. Of the 5,734 samples, 38% were involved in caregiving for either their own parents or their spouse's parents. There are cases where individuals answered that they are "providing care" even when their parent is in a nursing home. Although not included in this table, of the 1,182 respondents who answered that their own or their spouse's parent is in a nursing home, 495 also reported that they are providing care. This may reflect situations where, despite the parent being institutionalized, the individual still visits or brings clothing and daily necessities. Among the 1,593 individuals living with their own or their spouse's parents, 50% were caregivers. In contract, among 4,795 individuals living separately from their own or their spouse's parents, 32% were caregivers. Given the average age of the sample, it is evident that living together increases the likelihood of providing care in Japan. Among the individuals involved in caregiving for their parents or parents-in-law, the average caregiving time is 6.8 hours per day and 10.7 hours per week. The differences between daily and weekly average caregiving hours stem from the use of different survey instruments, as describe in Section 3.1. The former is derived from the main survey, while the latter is collected through a leave-behind questionnaire. Regarding the duration of caregiving, the average duration for the full sample (including non-caregivers) was 0.6 periods × 2 years = 1.2 years, while the average for caregivers who provide care at least one time

in three survey periods was 1.13 periods × 2 years = 2.26 years. It is important to note that this calculation excludes the possibility of caregiving before the first survey wave (2007). If caregiving started before 2007, the duration would be underestimated. Therefore, the reported duration should be considered a lower bound. Lastly, 21% of individuals have parents residing in a nursing home.

Table 2 shows descriptive statistics of the main variables using the whole sample of all three waves. I divided the sample based on whether the individuals became caregivers over the three survey periods. This data is an unbalanced panel with repeated observations. Table 2 shows that the average age of caregivers was 59.7 years, while that of non-caregivers was 60.0 years. 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, and a similar trend can be observed in the JSTAR used in this study.

Next, regarding employment status, 75% of individuals are employed, with 74% of caregivers and 76% of non-caregivers being employed. The proportion of employed individuals is higher among non-caregivers. In terms of working hours, among those who are employed, the average weekly working hours are 39.19 hours. Caregivers work an average of 38.97 hours, while non-caregivers work an average of 39.33 hours. Caregivers had a slightly lower proportion of full-time workers (34% vs. 35%). 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 for in the analysis. In Table 2, it is observed that more caregivers are female (1.53 vs. 1.42), have fewer children (1.92 vs. 1.97), are in better health, and tend to be in higher income categories and have higher educational levels.

4 EMPIRICAL ANALYSIS

The goal of this study is to assess the effect on a caregiver's labor supply by informal caregiving. As previously noted, this analysis focus on controlling for the endogeneity of informal caregiving decision through the standard approach of instrumental variables estimation. As for instrumental variables for the informal care, the certified long-term care (LTC) level of parents is possible candidates as it can be correlated to how much care is needed regardless of the type of care, i.e., receiving nursing care and/or informal care. 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, …, 3 for individual i = 1,…, n and Y_{it} is the labor supply dummy and hours of work, which estimate separately. In equation (1), H_{it} indicates the

instrumental variables which determine the caregiving decision. x_{it} are characteristics of children, that is, age, age squared, gender, marital status, number of children, 4 levels of self-reported health, quantile of log of per capita household income and educational categories.

The main interest of caregiving variables consists of dummy variable 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 is weekly and daily log transformed informal care hours plus one to include the people not providing informal care[6]. 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). In addition to the hours of care, the effects of duration of caregiving is estimated. Respondents were given a care period of 6 years if they provide informal care to parents for 3 consecutive periods of survey, 4 years if they provide care for 2 consecutive periods, and 2 years if they were providing care for only 1 period of survey.

The objective measure of level of parental care needs are used as instruments. Overidentification restriction test assess the validity of the set of instruments. Based on the result of p-value, the null hypothesis of endogeneity cannot be rejected at conventional significance levels (e.g., 0.05 or 0.01). Therefore, we conclude that the instrumental variables used in the model are valid and the model is not overidentified. There is no evidence of overidentification problems, indicating that the instruments are appropriate, and the model is properly specified.

5 RESULTS

5.1 Decision to provide informal care or utilize nursing home.

As in Figure 1, even when parents have the same certified level of LTC needs, some choose institutional care, and others choose informal care for them. The first question, then, is how the decision to provide informal care or to utilize institutional care is made. To answer this question, the ordinary least squares (OLS) model estimates whether the parents' certified LTC level as well as the children's gender, health status, and income, influenced this decision.

Table 3 shows the first-stage regression results for several specifications of caregiving. The LTC level is clearly a significant predictor of whether children provide care to their parents. Comparing separated and cohabiting parents in columns 2 and 3, those living with their parents provide more informal care compared to those living separately, even when the LTC level is the same (0.174 vs. 0.115). Both the hours of informal care per week and hours per day increase by 0.47% and 0.35% as the LTC level increases by one degree. For each one-unit increase in the LTC level, the log of caregiving hours per day and per week increases by 0.469 and 0.354. Given that the dependent variable is in logarithmic form, this result can be interpreted as a 0.47% and 0.35% increase in weekly or daily caregiving hours for every one-unit increase in the LTC level. The statistical significance of the coefficient suggests that the relationship between care needs level and caregiving hours is not due to random variation but is robustly associated

[6] In the previous studies, weak care hours were defined as less than 20 hours of care per week, and intensive care hours were defined as more than 20 hours per week.

with the level of caregiving required. In summary, as the LTC level increases, individuals provide substantially more informal care, with caregiving hours increasing by approximately 0.4% for each additional unit of LTC level. Furthermore, examining the coefficient of the squared term for LTC level, I find that it is statistically significant and negative. The all explanatory variables except for using a nursing home. This indicates an inverted U-shaped relationship between LTC level and informal care hours. In other words, while informal care hours increase up to a certain LTC level, beyond that point, they begin to decrease. As for the caregiving duration (ranging from 0 to 3, corresponding to 0 to 6 years, as the data is recorded in 2-year intervals), the estimated coefficient of 0.228 suggests that for each one-unit increase in the LTC level, the caregiving duration increases by 0.228 units. Given that one unit of period corresponds to two years, this result indicates that an increase of one unit in the LTC level is associated with an additional 0.46 years of caregiving. For example, if the LTC level increases by 3 units, the caregiving duration is expected to increase by approximately 1.37 years ($0.228 \times 3 \times 2$ years). This positive and statistically significant coefficient suggests that as care needs intensify, the caregiving duration also increases. The findings imply that higher levels of care dependency necessitate longer periods of informal caregiving, reflecting the increasing demand for caregiving as the LTC level rises.

The next issue I want to look at is the decision to use a care home or not. As expected, when the probability increases by 0.074 as the LTC level goes up by one degree, and the positive coefficient of the squared term indicates that the higher the LTC level, the 7.4% higher the probability of nursing home use. Furthermore, the coefficient for the quadratic term of LTC level is 0.004, which suggests that the probability of nursing home use increases at an accelerating rate as LTC levels rise. Both coefficients are statistically significant, indicating a robust relationship between LTC level and nursing home use. The positive coefficients for both the linear and quadratic terms imply an upward-sloping curve, rather than an inverted U-shaped relationship which was seen in informal caregiving variables. This suggests that while the likelihood of nursing home use increases with rising LTC levels, the rate of increase becomes more pronounced at higher LTC levels. These results show that family informal caregiving and the level of care required are complementary up to a certain point in time but change to a substitutive relationship from a certain point in time. This is a result not found in previous studies.

There are other interesting patterns in personal characteristics that influence an individual's likelihood to provide care for elderly parents. When examining gender differences, it is statistically significant that daughters and daughters-in-law are more likely to provide informal caregiving compared to sons and sons-in-law. However, no such gender difference was observed in the use of nursing home services. Younger ages are more likely to be involved in caregiving for parents both who live together and who live separately. However, there was only a weak correlation between the child's age and caregiving hours or duration. For example, while a one-year increase in the child’s age resulted in a statistically significant 0.043% increase in daily caregiving hours, no such relationship was observed for weekly caregiving hours or the total number of caregiving years. It is likely that as the child's age increases, the parent's age also rises, leading to greater caregiving needs. However, these needs are likely controlled for by the objective assessment of care requirements, as reflected in the LTC level. For the duration of caregiving, the healthier the adult children themselves are, the longer they are engaging in care. Looking at

the effect by income, income and hours per day of informal care are negatively correlated. This is also related to working hours and will be discussed in the following analysis.

5.2 Main results

This study aims to identify whether caregiving situations—such as caregiving provision, caregiving hours, caregiving duration, and nursing home use—affect labor outcomes. For labor, the analysis examines the effect on the intensive margin of employment, that is, the working hours. Given the possibility that caregiving situations may influence labor outcomes, and that exogeneity was rejected through testing, OLS estimates may suffer from endogeneity bias. To address this bias, instrumental variables are employed to estimate the causal effect of caregiving on labor outcomes. Then, I also analyze the effect on the extensive margin, that is, the employment. The key explanatory variables pertain to caregiving. These include whether the individual provides care, whether care is provided to a co-residing parent or a non-co-residing parent, the logarithm of average weekly caregiving hours, the logarithm of average daily caregiving hours, the duration of caregiving with one period representing two years, and whether the parent resides in a nursing home. Each caregiving variable is estimated separately. Other explanatory variables, common across all estimations, include age, age squared, gender, marital status, number of children, subjective health, income level, and educational categories.

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

First, 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 work 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. As shown in Table 4, the high p-values (Robust score chi2(1) = 8.71721, p = 0.0032) from the test led to the rejection of the null hypothesis that the variables are 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 and IV-FE models. The estimation results are shown in Table 4.

The results show that caregiving for a parent reduces working hours by 29.4%, a statistically significant effect. This suggests that individuals who provide care tend to work significantly fewer hours,

likely due to the competing demands of caregiving and employment. The IV-FE coefficient of caregiving for a parent -0.016 is also negative but not statistically significant. This suggests that, when controlling for individual fixed effects which are characteristics that do not change over time, such as pre-existing preferences for less hours of work or family caregiving responsibilities, caregiving does not have a statistically significant impact on working hours. The smaller coefficient and lack of significance imply that once these fixed individual factors are accounted for, the direct impact of caregiving on working hours diminishes. When examining the differential effects of caregiving based on co-residence with parents, results indicate that providing care to a co-residing parent reduces working hours by 39%, while caregiving for a non-co-residing parent decreases working hours by 27%. This suggests that co-residence may lead to greater adjustments in working hours, potentially due to the increased time spent with the parent in need of care. Regarding the hours of caregiving, the 2SLS coefficient of log hours of weekly caregiving and daily caregiving, -0.117 and -0.151 respectively, indicates that a 1% increase in weekly and daily caregiving hours is associated with a 0.12% and 0.15% reduction in working hours, and these results is statistically significant. This suggests that individuals who spend more time on caregiving each day and week significantly reduce their working hours, likely because caregiving demands are time-consuming and directly interfere with hours of work. However, the null hypothesis that the use of a nursing care has no effect on working hours could not be rejected. It suggests that institutional care may alleviate some of the direct caregiving burden. Once a parent enters a facility, the necessity for hands-in care by family members diminishes, allowing children to maintain their labor supply.

Who, then, faces the challenge of balancing working hours and caregiving hours? In the following analysis, I estimate the model separately by gender (Table 5) and employment type (Table 6). Table 5 presents the 2SLS estimation results by gender. For women, caregiving was found to significantly reduce working hours. Women who provide care reduce their working hours by 52%, and the reduction is even greater when caring for non-cohabiting parents, where working hours decrease by 58%. More specifically, a 1% increase in weekly caregiving hours leads to a 0.16% decrease in women's working hours, while a 1% increase in daily caregiving hours results in a 0.24% reduction in working hours. Additionally, as caregiving duration increases, its impact on reducing working hours becomes more pronounced by 0.42%. When using a nursing home, the reduction in working hours is smaller but statistically significant, at 18%. 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.

Furthermore, 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 cohabiting parents, who are most often their own parents in Japan. This trend is not observed for non-cohabiting 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-cohabiting parents or for their spouse's parents.

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 the second column, part-time workers reduce their working hours by 0.41% and full-time workers reduce by 0.074% due to caregiving, and this effect is even greater when caregiving for cohabiting parents, where working hours decrease by 0.82% for part-time workers. In terms of time, a 1% increase in weekly (or daily) caregiving hours leads to a 0.24% (or 0.14%) reduction in weekly working hours for part-time workers. Surprisingly, full-time workers also reduce their working hours due to caregiving. For non-cohabiting parents, full-time workers reduce their working hours by 0.15%. Additionally, a 1% increase in daily caregiving hours results in a 0.034% decrease in full-time workers' working hours. Moreover, as caregiving duration increases, part-time workers reduce their working hours by 0.3%, and full-time workers reduce theirs by 0.061%. The analysis reveals that as daily caregiving hours increase or the duration of caregiving extends, even full-time workers experience a statistically significant reduction in their working hours.

5.2.2 Impact of caregiving on employment probability (Extensive margin)

Next, I conducted the estimation of caregiving on the extensive margin (employment) by an OLS estimation, followed by a fixed-effects model estimation that accounts for individual fixed effects. 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 use 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 fixed-effects model allows us to estimate the effects of time-varying factors, such as caregiving provision and caregiving hours, while controlling for time-invariant unobserved variables (e.g., personality traits or family values) that may influence labor supply. The results of the endogeneity test show that robust score chi-squared test (chi-squared (1) = 0.147889, p = 0.7006) indicate that null hypothesis that caregiving is exogenous cannot be rejected. Caregiving provision does not have an endogenous effect on labor force participation. This is in line with the results of Oshio&Usui (2018), which also mentioned that “potential endogeneity is not a serious concern” in Japanese context. Therefore, reliable results can be obtained from the OLS and FE models.

As shown in the results in Table 7, caregiving has a negative impact on labor supply in the OLS estimation, with a 3.4 percentage points reduction in the probability of employment. 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. The smaller effect observed in this study may reflect differences in sample composition or the inclusion of both male and female caregivers, highlight in potential gender differences in caregiving’s impact on labor supply. While a similar negative effect was observed in the fixed effects (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. As a result, in the OLS model, caregiving effects may have been confounded with individual fixed characteristics that also influence labor force participation, leading to the observed stronger negative effect. On the other hand, in

the FE model, since these individual-specific characteristics are controlled for, the direct effect of caregiving is weakened, and the impact is no longer statistically significant.

Next, I examined the impact of caregiving for cohabiting and non-cohabiting parents on labor supply. Providing care for non-cohabiting parents reduces the probability of labor force participation by 4.1 percentage points. This suggests that geographical distance and caregiving burden to separately lived parents may significantly drive labor market exit. In contrast, for cohabiting parents, none of the models yielded statistically significant results, indicating that caregiving for cohabiting parents does not have a significant effect on labor force participation. In cohabiting situations, caregiving likely becomes part of daily life, and whether or not an individual provides care may not directly affect their labor supply. However as in the previous section 5.2.1, the hours of caregiving to cohabited parents have substantial negative effects to hours of work.

Caregiving hours per day and the duration of caregiving also affect labor supply. The null hypothesis that caregiving hours and caregiving duration are endogenous was not rejected at the 10% significance level in robust score chi-squared test, indicating that 2SLS estimation is more appropriate for accurate measurement. As with the previous estimation, this study employs the long-term care needs certification level of the parent and its square as instrumental variables. The 2SLS estimation results for these variables show that a 1% increase in caregiving hours per day results in a 0.043% decrease in labor supply. Additionally, a two-year increase in caregiving duration reduces labor supply by 0.067%. 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 extend over time. This suggests that even small changes in caregiving hours can lead to significant long-term effects.

Table 8 present the results of the OLS estimates by gender. Caregiving reduces labor supply for both women and men. Women who provide care have 4.8 % less likely to be employed compared to non-caregivers, while men's employment probability decrease by 3%. This effect is further pronounced for non-caring for non-cohabiting parents, with a 3.7% reduction in employment probability. On the other hand, caregiving for parents in nursing homes was found to significantly reduce women's labor supply. Previous studies have not thoroughly examined the impact of nursing home use on labor supply. Individuals with parents in nursing homes who often have higher level of care needs, and many of their children may have already exited the labor market due to caregiving responsibilities or their own age.

Lastly, I compare the findings with the results of Oshio and Usui (2018). Their study focused on women under 60 years old, reporting a 5.4% reduction in labor supply based on OLS estimate. However, in my robustness check for women under 60, no statistically significant evidence was found to suggest that caregiving leads to labor market exit (Table 9). My analysis, however, extends to examine the impact of caregiving hours. The results indicate that longer caregiving hours reduce women's labor participation by 3.4%. This suggests that key issue may not lie in caregiving itself but in the time commitment required for caregiving. Hence, the ability to balance caregiving with working hours is crucial for sustaining labor force

participation. Additionally, caregiving for parents in nursing homes is associated with a 7% reduction in women's labor supply. This finding implies that individual under 60 are more likely to have already exited the labor market when their parent requires intensive care and reside in a nursing home.

6 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 reduces the probability of employment for adult children. However, the amount of time dedicated to caregiving plays a more significant 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 result show that a 1% increase in daily caregiving hours leads to a 0.015% reduction in working hours. Moreover, extending caregiving period by two years reduces working hours by 0.23% and decreases the probability of employment by 6.7%.

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 evidence that informal caregiving significantly reduces 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. 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 uncovers important gender differences in the impact of caregiving. While caregiving responsibilities are typically associated with women, the results reveal that caregiving significantly reduces the employment probability of both women and men. Although the effect is more pronounced for men, men also experienced reductions in employment as a result of caregiving. The results also indicate that caregiving affects not only women's working hours but men's as well. Notably, 18% of women whose parents reside in nursing homes report a reduction in working hours, reflecting the continuing demands of indirect caregiving responsibilities.

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 work

arrangements and caregiving leave policies to align with the needs of informal caregivers, employers, and the government.

Table 1 Summary statistics of caregiving variables

Variable	Obs	Mean	Std. dev.	Min	Max
Caregiving for parents	5,734	0.38	0.49	0	1
Caregiving for parents live separately	4,795	0.32	0.47	0	1
Caregiving for parents live together	1,593	0.50	0.50	0	1
Log hours of caregiving per week	4,609	0.29	0.79	0	4.9
Log hours of caregiving per day	5,734	0.18	0.58	0	3.2
Period of caregiving	5,734	0.61	0.60	0	3
Nursing home use	5,734	0.21	0.40	0	1

Table 2 Summary statistics of explanatory variables

	All		Caregivers		Not caregivers	
	Obs	Mean	Obs	Mean	Obs	Mean
Age	5,517	59.7	2,092	58.93	3,425	60.1
Gender (1 = Male, 2 = Female)	5,734	1.46	2,188	1.53	3,546	1.42
Working dummy	5,589	0.75	2,134	0.74	3,455	0.76
Hours of work per week	3,698	39.19	1,419	38.97	2,279	39.33
Labor force						
Full-time workers	5,589	0.35	2,134	0.34	3,455	0.35
Part-time workers	5,589	0.21	2,134	0.21	3,455	0.21
Self-employed	5,589	0.15	2,134	0.14	3,455	0.16
Unemployed	5,589	0.04	2,134	0.05	3,455	0.04
Marital status (1 = Married, 0 = Not married)	5,691	0.86	2,179	0.86	3,512	0.86
Number of children	5,720	1.95	2,186	1.92	3,534	1.97
Self-reported health						
1.Excellent	5,711	0.26	2,179	0.26	3,532	0.26
2.Very Good	5,711	0.26	2,179	0.27	3,532	0.25
3.Good	5,711	0.36	2,179	0.34	3,532	0.37
4.Fair	5,711	0.11	2,179	0.11	3,532	0.10
5.Poor	5,711	0.02	2,179	0.02	3,532	0.02
Log of household income per capita						
lowest 25%	5,295	0.19	2,040	0.19	3,255	0.20
25～50%	5,295	0.24	2,040	0.23	3,255	0.25
50~75%	5,295	0.26	2,040	0.26	3,255	0.27
highest 25%	5,295	0.30	2,040	0.32	3,255	0.29
Educational attainment						
Primary education	5,719	0.00	2,185	0.00	3,534	0.00
Lower secondary education	5,719	0.18	2,185	0.18	3,534	0.18
Upper secondary education	5,719	0.44	2,185	0.42	3,534	0.45
Post-secondary non tertiary education	5,719	0.09	2,185	0.10	3,534	0.09
First stage of tertiary education	5,719	0.29	2,185	0.30	3,534	0.28
Second stage of tertiary education	5,719	0.00	2,185	0.00	3,534	0.00

Table 3 The first stage result of the estimation: Informal caregiving or Nursing home use

	Caregiving for parents	Caregiving for parents live separately	Caregiving for parents live together	Log hours of caregiving per week	Log hours of caregiving per day	Period of caregiving	Nursing home use
Parent's LTC level	0.168***	0.115***	0.174***	0.469***	0.354***	0.228***	0.074***
	[13.264]	[8.368]	[7.701]	[21.139]	[23.936]	[14.648]	[8.914]
Parent's LTC level square	-0.020***	-0.013***	-0.019***	-0.058***	-0.045***	-0.027***	0.004***
	[-9.874]	[-5.955]	[-5.041]	[-16.264]	[-19.089]	[-10.973]	[3.160]
Age	-0.104***	-0.083***	-0.181***	0.019	0.043*	0.037	-0.021
	[-4.809]	[-3.571]	[-4.488]	[0.500]	[1.689]	[1.390]	[-1.443]
Age square	0.001***	0.001***	0.001***	-0.000	-0.000*	-0.000	0.000
	[4.303]	[3.184]	[4.354]	[-0.593]	[-1.749]	[-1.544]	[1.519]
Gender (1 = Male, 2 = Female)	0.083***	0.102***	0.100***	0.218***	0.042**	0.095***	-0.008
	[5.670]	[6.549]	[3.679]	[8.541]	[2.485]	[5.301]	[-0.828]
Marital status (1 = married, 0 = not married)	0.040*	0.016	0.084**	-0.066*	-0.032	-0.020	0.038**
	[1.773]	[0.598]	[2.076]	[-1.663]	[-1.216]	[-0.707]	[2.524]
Number of children	-0.009	-0.014*	-0.014	-0.017	-0.003	0.006	-0.002
	[-1.236]	[-1.782]	[-0.967]	[-1.267]	[-0.294]	[0.606]	[-0.495]
Self-reported health (ref. = Excellent)							
Very good	0.034*	0.044**	0.039	-0.001	0.026	0.064***	-0.012
	[1.771]	[2.129]	[1.112]	[-0.036]	[1.135]	[2.704]	[-0.971]
Good	0.006	0.016	-0.019	0.018	0.033	0.053**	0.001
	[0.325]	[0.817]	[-0.570]	[0.569]	[1.577]	[2.370]	[0.101]
Fair	0.037	0.051*	-0.032	0.063	0.027	0.055*	0.000
	[1.395]	[1.806]	[-0.680]	[1.355]	[0.872]	[1.693]	[0.019]
Poor	-0.033	0.016	-0.118	-0.134	-0.063	-0.110	0.032
	[-0.577]	[0.274]	[-0.886]	[-1.371]	[-0.932]	[-1.560]	[0.851]
Log of household income per capita (ref. =Lowest 25%)							
25～50%	-0.002	0.010	-0.053	-0.033	-0.049*	0.015	0.006
	[-0.107]	[0.424]	[-1.295]	[-0.886]	[-1.920]	[0.570]	[0.395]
50~75%	0.004	0.002	-0.021	-0.057	-0.051**	0.028	0.015
	[0.203]	[0.078]	[-0.539]	[-1.511]	[-2.027]	[1.053]	[1.076]
highest 25%	0.022	0.043*	-0.051	-0.042	-0.056**	0.029	0.016

	[1.011]	[1.856]	[-1.306]	[-1.130]	[-2.224]	[1.105]	[1.144]
Educational attainment (ref.= Primary education)							
Lower secondary education	-0.072	-0.003	-0.096	0.283	0.140	-0.021	0.034
	[-0.342]	[-0.012]	[-0.288]	[0.669]	[0.569]	[-0.083]	[0.242]
Upper secondary education	-0.136	-0.023	-0.166	0.235	0.057	-0.105	0.044
	[-0.645]	[-0.086]	[-0.499]	[0.554]	[0.234]	[-0.404]	[0.319]
Post-secondary non tertiary education	-0.121	-0.033	-0.110	0.298	0.130	-0.055	0.019
	[-0.572]	[-0.123]	[-0.328]	[0.701]	[0.528]	[-0.210]	[0.137]
First stage of tertiary education	-0.121	-0.004	-0.142	0.316	0.070	-0.092	0.025
	[-0.573]	[-0.016]	[-0.425]	[0.744]	[0.284]	[-0.354]	[0.178]
Second stage of tertiary education	-0.092	-0.034	0.378	0.229	0.043	-0.286	0.013
	[-0.356]	[-0.111]	[0.661]	[0.468]	[0.142]	[-0.905]	[0.077]
Constant	3.761***	2.888***	6.009***	-0.854	-1.305	-0.577	0.581
	[5.455]	[3.849]	[4.779]	[-0.686]	[-1.623]	[-0.681]	[1.280]
Observations	4,472	3,735	1,341	3,544	4,472	4,472	4,472
R-squared	0.096	0.073	0.143	0.219	0.182	0.101	0.385

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 4 Effect of informal caregiving on log hours of labor (2SLS and IV-FE)

	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE
Caregiving for parents	-0.294***	-0.016												
	[-2.925]	[-0.125]												
Caregiving for parents live separately			-0.270*	0.017										
			[-1.717]	[0.097]										
Caregiving for parents live together					-0.387***	-0.076								
					[-2.718]	[-0.325]								
Log hours of caregiving per week							-0.117***	0.068						
							[-2.717]	[0.660]						
Log hours of caregiving per day									-0.151***	0.017				
									[-3.012]	[0.252]				
Period of caregiving											-0.231***	-0.079		
											[-2.902]	[-0.592]		
Nursing home use													-0.076	-0.087
													[-1.634]	[-0.901]
Wave dummy		Yes		Yes		Yes		Yes		Yes		Yes		Yes
Observations	2,975	2,975	2,479	2,479	950	950	2,328	2,328	2,975	2,975	2,975	2,975	2,975	2,975
R-squared	0.122		0.155		0.057		0.160		0.160		0.122		0.174	
Number of id		1,989		1,741		626		1,608		1,989		1,989		1,989
Robust Score Chi-Squared Test (p-value)	0.0032		0.1096		0.0052		0.0781		0.0022		0.0015		0.0596	

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, marital status, number of children, education, household income quantile, which are the same with Table 3.

Table 5 Effect of informal caregiving and nursing home use on log hours of labor *by gender* (2SLS model)

	male	female	male	female	male	female
Caregiving for parents	-0.109	-0.521***				
	[-0.952]	[-2.941]				
Caregiving for parents live separately			-0.019	-0.581**		
			[-0.112]	[-2.030]		
Caregiving for parents live together					-0.326*	-0.409*
					[-1.689]	[-1.665]
Other socio-economics variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,851	1,124	1,510	969	657	293
R-squared	0.106		0.125			0.062

	male	female	male	female	male	female	male	female
Log hours of caregiving per week	-0.054	-0.160***						
	[-0.775]	[-2.872]						
Log hours of caregiving per day			-0.061	-0.239***				
			[-0.994]	[-3.020]				
Period of caregiving					-0.085	-0.421***		
					[-0.978]	[-2.900]		
Nursing home use							-0.003	-0.179**
							[-0.061]	[-2.140]
Other socio-economics variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,454	874	1,851	1,124	1,851	1,124	1,851	1,124
R-squared	0.116	0.036	0.112	0.031	0.103		0.118	0.050

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, marital status, number of children, education, household income quantile, which are the same with Table 3.

Table 6 Effect of informal caregiving and nursing home use on log hours of labor *by employment* (2SLS model)

	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Caregiving for parents	-0.074*	-0.406**				
	[-1.703]	[-2.467]				
Caregiving for parents live separately			-0.150**	-0.305		
			[-2.242]	[-1.209]		
Caregiving for parents live together					0.053	-0.816***
					[0.791]	[-3.050]
Other socio-economics variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,512	874	1,283	737	485	230
R-squared				0.040	0.060	

	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Log hours of caregiving per week	-0.019	-0.140**						
	[-1.084]	[-2.088]						
Log hours of caregiving per day			-0.034*	-0.242**				
			[-1.703]	[-2.486]				
Period of caregiving					-0.061*	-0.303**		
					[-1.713]	[-2.408]		
Nursing home use							-0.028	-0.122
							[-1.453]	[-1.224]
Other socio-economics variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,166	696	1,512	874	1,512	874	1,512	874
R-squared	0.040	0.069	0.024	0.047	0.013	0.005	0.050	0.071

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, gender, marital status, number of children, education, household income quantile, which are the same with Table 3.

Table 7 Effect of informal caregiving on employment (OLS, FE, 2SLS, IV-FE)

	OLS	FE	OLS	FE	OLS	FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE	2SLS	IV-FE
Caregiving for parents	-0.034***	-0.013												
	[-3.012]	[-1.062]												
Caregiving for parents live separately			-0.041***	-0.000										
			[-3.213]	[-0.005]										
Caregiving for parents live together					-0.007	-0.002								
					[-0.364]	[-0.082]								
Log hours of caregiving per week							-0.025	-0.036						
							[-1.214]	[-1.168]						
Log hours of caregiving per day									-0.043*	-0.010				
									[-1.684]	[-0.338]				
Period of caregiving											-0.067*	-0.030		
											[-1.875]	[-0.591]		
Nursing home use													-0.062**	-0.022
													[-2.306]	[-0.626]
Wave dummy		Yes		Yes		Yes		Yes		Yes		Yes		Yes
Observations	4,949	4,949	4,162	4,162	1,381	1,381	3,461	3,461	4,377	4,377	4,377	4,377	4,377	4,377
R-squared	0.245	0.066	0.249	0.065	0.238	0.067	0.233		0.234		0.231		0.239	
Number of id		3,162		2,812		854		2,314		2,806		2,806		2,806
Robust Score Chi-Squared Test (p-value)							0.4188		0.0956		0.0876		0.7257	

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, marital status, number of children, education, household income quantile.

Table 8 Effect of informal caregiving on employment *by gender* (OLS)

	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Caregiving for parents	-0.030*	-0.048**												
	[-1.852]	[-2.420]												
Caregiving for parents live separately			-0.037*	-0.037*										
			[-1.951]	[-1.673]										
Caregiving for parents live together					-0.039	-0.053								
					[-1.484]	[-1.314]								
Log hours of caregiving per week							-0.014	-0.014						
							[-0.960]	[-1.170]						
Log hours of caregiving per day									-0.005	-0.024				
									[-0.319]	[-1.552]				
Period of caregiving											-0.002	-0.005		
											[-0.174]	[-0.341]		
Nursing home use													-0.001	-0.049**
													[-0.073]	[-2.071]
Observations	2,737	2,212	2,251	1,911	864	517	2,221	1,743	2,737	2,212	2,737	2,212	2,737	2,212
R-squared	0.170	0.151	0.181	0.148	0.137	0.173	0.204	0.151	0.169	0.149	0.169	0.148	0.169	0.150

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, marital status, number of children, education, household income quantile, which are the same with Table 3.

Table 9 Robustness check: Effect of informal caregiving on log hours of work *by gender, age under 60* (OLS)

	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Caregiving for parents	-0.000	-0.022												
	[-0.032]	[-0.961]												
Caregiving for parents live separately			-0.005	-0.010										
			[-0.590]	[-0.408]										
Caregiving for parents live together					0.011	-0.023								
					[0.895]	[-0.518]								
Log hours of caregiving per week							0.001	-0.010						
							[0.116]	[-0.741]						
Log hours of caregiving per day									-0.004	-0.034*				
									[-0.509]	[-1.820]				
Period of caregiving											0.004	0.008		
											[0.494]	[0.382]		
Nursing home use													0.012	-0.070**
													[1.079]	[-2.406]
Observations	1,578	1,407	1,321	1,234	564	360	1,228	1,066	1,578	1,407	1,578	1,407	1,578	1,407
R-squared	0.119	0.081	0.148	0.077	0.079	0.162	0.136	0.071	0.119	0.083	0.119	0.081	0.120	0.085

t-statistics in brackets *** p<0.01, ** p<0.05, * p<0.1, Other socio-economics variables include age, age squared, marital status, number of children, education, household income quantile, which are the same with Table 3.

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.

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

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.

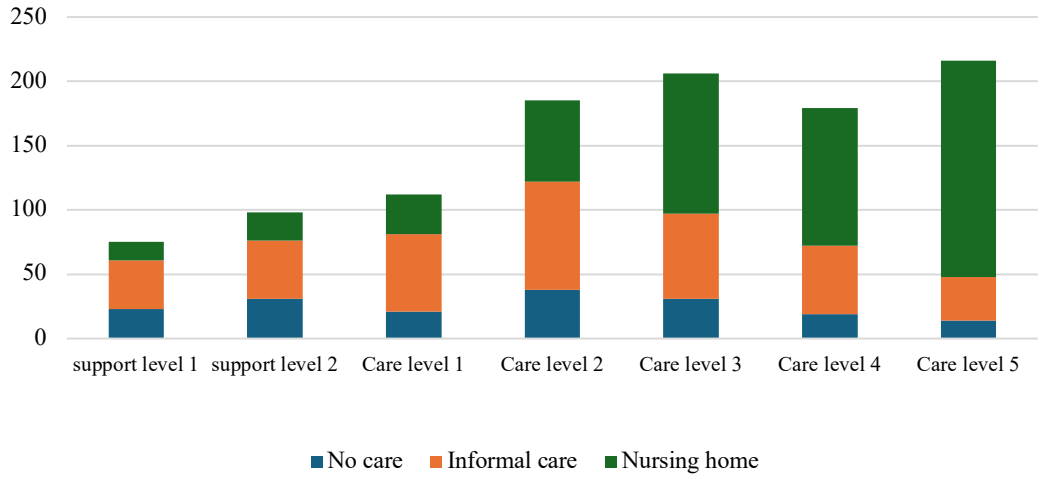
United Nations. Department of Economic and Social Affairs, Population Division (2022). *United Nations Database on the Households and Living Arrangements of Older Persons 2022*. DESA/POP/2022/DC/No.7.

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.

Appendix Figure

(A) Own parent



(B) Spouse parents

