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The association between involvement in family caregiving and mental health among middle-aged adults in Japan

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ABSTRACT

It is widely known that the mental health of middle-aged adults is closely associated with involvement in family caregiving, as well as socioeconomic and sociodemographic factors. However, most studies focusing on mental health in adulthood have not fully controlled for time-invariant factors. Moreover, the relative importance of factors associated with mental health has remained largely understudied. In the current study, we employed fixed-effects regression models to examine the manner in which middle-aged adults' mental health is associated with involvement in family caregiving and socioeconomic and sociodemographic factors, after controlling for time-invariant factors. Using data from a population-based, six-year panel survey in Japan, we focused on the evolution of the Kessler 6 (K6) scores (range: 0–24) for 26,522 individuals (12,646 men and 13,876 women) aged 50–59 years in 2005 over the subsequent five years. We found that men and women experienced 0.54 (95% CI 0.44–0.64) and 0.57 (95% CI 0.49–0.66) unit increases in their K6 scores, respectively, when they became involved in care provision for any family member. This magnitude of distress exceeded that associated with any socioeconomic or sociodemographic factor examined in this study. Furthermore, we found that care provision to a mother-in-law had an additional, negative association with mental health for female caregivers, as opposed to men. These findings suggest that more panel studies are needed to examine the correlates of mental health among middle-aged adults.

1. Introduction

It is widely known that family care provision is closely associated with mental health in adulthood. Previous studies have found that family members' involvement in nursing care tends to adversely affect their psychological well-being (e.g., Amirkhanyan and Wolf, 2006; Bookwala, 2009; Ennis and Bunting, 2003; Sugihara et al., 2004). An aging population and declining fertility are likely to increase the risks of psychological distress associated with individuals' provision of care to their elderly parents and parents-in-law, unless public nursing services and/or support for family caregiving are sufficiently provided.

Middle-aged adults also contend with many socioeconomic and sociodemographic factors that could negatively affect their mental health. Among others, household income, employment status, marital status, co-residence with family members, and participation in social activities have been found to closely correlate with psychological distress (e.g., Butterworth et al., 2009; Kaplan et al., 2008; Lorant et al., 2007; Sareen et al., 2011).

In recent years, an increasing number of studies on mental health in adulthood have utilized panel, rather than cross-sectional data. Even with the use of longitudinal information, however, most studies have relied heavily on the analysis of the data over two time points (baseline and follow-up years) without fully controlling for time-invariant confounders, especially unobserved ones. This probably led to biased estimation results.

In the current study, we sought to validate previous findings on the correlates of mental health in adulthood by removing the effects of time-invariant factors. There are two types of time-invariant factors: observed and unobserved. Observed time-invariant variables include gender and educational background (as far as the analysis focuses on middle-aged adults), which are usually observed from a survey. Unobserved time-invariant factors are not observable from a survey. In the current study, personality traits, intelligence quotient (IQ), and other inherent individual attributes, which did not appear on the dataset of the survey, were regarded as potential time-invariant factors.

We employed fixed-effects regression models to examine the manner in which the mental health of middle-aged adults was associated with involvement in family caregiving, as well as

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socioeconomic and sociodemographic factors, after controlling for both observed and unobserved time-invariant factors. To this end, we utilized data from a six-year nationwide survey in Japan. It included 26,522 individuals (12,646 men and 13,876 women) aged between 50 and 59 years in 2005; the study tracked developments in the participants' mental health, involvement in family caregiving, and socioeconomic and sociodemographic factors over the subsequent five years.

1.1. Background

Many preceding studies have shown that family caregiving tends to increase caregivers' psychological distress (e.g., Amirkhanyan and Wolf, 2006; Bookwala, 2009; Ennis and Bunting, 2003). The association has also been found to differ between male and female caregivers (Amirkhanyan and Wolf, 2006; Bookwala, 2009), and is seemingly affected by kinship between caregivers and care recipients (Pinquart and Sörensen, 2011).

It should be noted, however, that the observed associations are likely to have been confounded by time-invariant variables. In order to investigate the associations accurately, we have to control for as many time-invariant factors as possible that could potentially confound the associations. Some longitudinal studies have investigated changes in the psychological well-being of caregivers over time (Haug et al., 1999; Pot et al., 1997; Sugihara et al., 2004), but the association between involvement in caregiving per se and mental health has remained largely understudied.

To assess the relative importance of family care provision as a correlate of mental health in adulthood, other factors that could likely affect mental health must be examined jointly. In this regard, socioeconomic factors such as income and employment status should be considered. A number of studies analyzing conventional measures of poverty or economic hardships found that these were negatively related to mental health (Butterworth et al., 2009; Kaplan et al., 2008; Lorant et al., 2007; Sareen et al., 2011). The adverse impact of unemployment on mental health has also been studied (Clark, 2003; Clark and Oswald, 1994).

Other than these socioeconomic factors, some sociodemographic factors have been found to be closely related to mental health. Researchers have provided evidence that widowhood and divorce tend to have a depressive effect, especially on men (Chipperfield and Havens, 2001; Jang et al., 2009; Lee et al., 2001). Family relations other than marital status may also play a role in mental health, especially in Japan and other Asian countries, where a multi-generational family setting is more prevalent than in Western countries. Indeed, studies have argued that Japanese women tend to encounter strain in traditional households, where caregiving for elderly parents traditionally takes place within the family setting (Mizuno and Takashaki, 2005; Nishi et al., 2010; Takeda et al., 2004).

Recent studies have focused on the importance of social relations for the maintenance of mental health in adulthood. In general, social activities are postulated to be crucial for successful aging, as regular social interaction increases older adults' chances of obtaining social support (Lin et al., 1999; Umberson et al., 1996). However, the importance of social relations may differ according to social background (Kikuzawa, 2006).

In Japan, the government initiated the long-term care insurance (LTCI) system in 2000 to help older people lead more independent lives and to relieve family caregivers of the burdens associated with their roles. However, according to statistics released by the Japanese Ministry of Health, Labour and Welfare (MHLW), more than 70% of nursing care is still provided at home. Meanwhile, Tsutsui et al. (2013) found changes in perceived filial obligation among family caregivers after the introduction of the LTCI system, which may affect the association between family caregiving and mental health. Hence, it is of great interest to examine whether family caregiving still serves as an important stressor among middle-aged adults.

1.2. The current study

The current study examined the association of mental health with family caregiving and socioeconomic and sociodemographic factors among Japanese adults aged 50–64 years. This study is expected to provide new insights into the correlates of adult mental health by considering three aspects.

First, the study employed fixed-effect regressions, which allowed for the removal of the effects of observed and unobserved time-invariant characteristics through individual mean-centering of each variable. This methodology has been widely used in studies examining the association between socioeconomic factors and mental health (Andrés, 2004; Lorant et al., 2007; McKenzie et al., 2014). We extended this methodology to the analysis of the association of mental health with family caregiving, as well as socioeconomic and sociodemographic factors.

Second, we intended to assess the relative importance of family caregiving in adults' mental health by comparing the magnitude and statistical significance of the association between mental health and family caregiving, as well as between the former and socioeconomic and sociodemographic factors. Previous studies have focused on the association of mental health with each of these factors selectively, leaving their relative importance largely understudied.

Third, we investigated how kin relationships between caregivers and care recipients confounded the association between family caregiving and mental health. Previous studies on family relations in Japan have pointed to the psychological strain between daughters-in-law and mothers-in-law (Mizuno and Takashaki, 2005); thus, we reasonably hypothesized that female caregivers caring for their mothers-in-law would experience greater distress than at other sub-sample in the current study.

2. Methods

2.1. Study sample

We used six-year panel data obtained from a nationwide, population-based survey, "The Longitudinal Survey of Middle-Aged and Older Adults." The survey was conducted by the MHLW between 2005 and 2010. Samples in the first wave were collected nationwide in November 2005 through a two-stage random sampling procedure. First, 2515 districts were randomly selected from 5280 districts used in the MHLW's nationwide, population-based "Comprehensive Survey of the Living Conditions of People on Health and Welfare," which was conducted in 2004. The 5280 districts were, in turn, randomly selected from about 940,000 national census districts. Second, 40,877 residents aged 50–59 years as of October 30, 2005 were randomly selected from each selected district, according to its population size.

The questionnaires were physically distributed to the participants' homes, where they were completed by the participants as of November 2, and physically collected several days thereafter. A total of 34,240 individuals responded (response rate: 83.8%). The second to sixth waves of the survey were conducted in 2006–2010 and consisted of 32,285, 30,730, 29,605, 28,736, and 26,220 respondents, respectively (response rate: 91.8–97.3%). Unlike in the first wave, the questionnaire was mailed only to individuals who had participated in the previous wave or the one prior to that, who

then mailed back the questionnaire. No new respondents were added after the first wave.

Excluding the respondents missing key variables and those whose data were discontinuous at least once through the six waves of the study, we used the data of 26,522 individuals (12,646 men and 13,876 women), who made up 78.4% of the respondents in the first wave. The total number of respondents, who were the same individuals participating in the different waves and included in the statistical analyses, was 137,490 (66,307 men and 71,183 women).

2.2. Measures

2.2.1. Psychological distress

We constructed Kessler 6 (K6) scores to measure psychological distress (Kessler et al., 2002, 2010). From the survey, we first obtained the respondents' assessments of psychological distress using a six-item psychological distress questionnaire – "During the past 30 days, about how often did you feel a) nervous, b) hopeless, c) restless or fidgety, d) so depressed that nothing could cheer you up, e) that everything was an effort, and f) worthless?" – rated on a 5-point scale (0 = *none of the time* to 4 = *all of the time*). Then, we calculated the sum of the reported scores (range: 0–24) and defined it as the K6 score. Cronbach's alpha coefficient was 0.894 for the entire sample included in the study from 2005 to 2010. Higher K6 scores reflect higher levels of psychological distress. K6 scores $\geq$13 indicate serious mental illness, whereas K6 scores $\geq$5 indicate mood/anxiety disorder in a Japanese sample; both of these constructs were validated by preceding studies (Kessler et al., 2010; Sakurai et al., 2011).

2.2.2. Family care provision

The survey included items relating to respondents' care provision to family member(s) (i.e., father, mother, father-in-law, mother-in-law, and others) at the time of the study. Of all the respondents, 24.5% provided nursing care to at least one family member at least once throughout the duration of the study. Moreover, 18.3% of the respondents in the first wave became newly involved in caregiving during the second and sixth waves, while 15% were relieved of their caregiving duties in the same period because of the death of the care recipients, care recipients' admission to nursing institutions, or other reasons.

We constructed a binary variable to which we allocated a "1" if the respondent indicated providing nursing care to at least one family member, regardless of living arrangements. In addition to this binary variable, we constructed five binary variables indicating nursing care provision for each of the five types of family members (i.e., father, mother, father-in-law, mother-in-law, and others).

2.2.3. Socioeconomic factors

We regarded household income as a key socioeconomic factor closely related to mental health, as already evidenced by previous studies. We constructed a binary variable of poverty based on household income. Specifically, we first combined income reported by a respondent and his/her spouse, if any, and divided the sum of the couple's income by the square root of the number of family members, in order to adjust for household size. This adjustment was based on recent publications of the Organisation for Economic Co-operation and Development (OECD, 2008; 2011). The MHLW released its official estimates of the poverty lines for 2003, 2006, and 2009, which were 130, 127, and 125 million yen, respectively (MHLW, 2011). We interpolated and extrapolated data relating to poverty lines for each wave in 2005–2010, using average household income obtained each year from the MHLW's "Comprehensive Survey of the Living Conditions of People on Health and Welfare." Finally, for each wave, we constructed a binary variable of poverty, for which respondents received a "1" if their household-size-adjusted income was below the poverty line; otherwise, respondents received a "0."

It should be noted that household income, as defined in the current study, most likely underestimated household income. We considered the income of the respondents and their spouses only, if available, since the income of other family members (including pension benefits obtained by elderly family members) could not be obtained from the survey. Hence, we should be cautious about interpreting results relating to the binary variable of poverty, which probably overestimated poverty.

We also investigated employment status. Based on the responses obtained, we divided employment status into three categories: e*mployed* (as a reference), *unemployed*, and *inactive*. Those not working were categorized as *unemployed* if they were seeking employment; otherwise, they were considered *inactive*.

2.2.4. Sociodemographic factors

With regard to sociodemographic factors, we first constructed a binary variable relating to having a spouse (i.e., marital status). A change from 1 to 0 in relation to this variable indicated that a respondent got married or remarried, while that from 0 to 1 indicated getting divorced or widowed (which could not be accurately identified from the survey). We also constructed a binary variable of co-residence with each family member (other than a spouse). A change from 1 to 0 in this regard indicated a shift from co-residence to separate residences or the death of the co-residing family member.

2.2.5. Social activities

We also considered social activities in our study. The respondents were asked whether they participated in each of the four specified types of social activities (i.e., community work, voluntary support for children, voluntary support for elderly individuals, and others). We constructed a binary variable relating to lack of social activity, which would equal "1" if a respondent did not participate in any type of social activity, and a "0" in case of participation in any activity.

2.2.6. Estimation strategy

To predict the K6 score, we estimated fixed-effects regression models in which all the variables were mean-centered for each individual over the estimation period (Baltagi, 2013; Wooldridge, 2010). Specifically, we considered the regression model (McKenzie et al., 2014):

$$y_{it} = \beta_{0t} + \beta_1 X_{it} + \beta_2 Z_i + \alpha_i + \varepsilon_{it},$$

where y_{it} is the K6 score of individual i at year t, β_{0t} is the time-varying intercept, X_{it} and Z_i are vectors of observed time-variant exposure variables and observed time-invariant variables, respectively, α_i is a vector of unobserved time-invariant variables, ε_{it} is an error term, and β_1 and β_2 are coefficient vectors.

In the current study, the observed time-variant exposure variables (X_{it}) included nursing care provision, poverty, occupational and marital statuses, co-residence with family members, and social activity. The observed time-invariant variables (Z_i) included gender and educational background. The unobserved time-invariant variables (α_i) arguably included IQ, personality traits, and other inherent individual characteristics.

The value, sign, and statistical significance of β_1 are of the greatest interest. However, the pooled ordinary least squares (OLS) model cannot obtain its unbiased estimator because α_i is unobserved and thus cannot be used in regressions. The fixed-effects model, which subtracts the mean over time from the actual value

for each variable, removes all observed and unobserved variables (Z_i and α_i) from the model, making it possible to obtain an unbiased estimator of β_1. To highlight the importance of controlling for time-invariant factors, we compared the results between pooled OLS and the fixed-effects regression model. We further estimated fixed-effects regression models separately for men and women, so as to examine gender differences.

To control for attrition bias, we employed inverse probability weighting (Wooldridge, 2002, 2010). We first estimated the probit models in order to predict observation presence at each wave of the study, using individual characteristics observed in the first wave. Then, we used the inverse of the predicted probability of presence as the weight when estimating regression models. Regression models without weighting (not reported) did not lead to any substantial difference in estimation results, presumably due to relatively low attrition rates.

Furthermore, we estimated fixed-effects logistic models to explain a binary variable of psychological distress, defined as K6 $\geq$ 5 by the above-mentioned set of explanatory variables. This regression analysis employed data from respondents who had experienced an increase from 0 to 4 to 5–24 in their K6 scores, or a decrease from 5 to 24 to 0–4 at least once throughout the duration of the study. The sample decreased to 5624 men and 6381 women, which were 44.5% and 46.0%, respectively, of the original subsamples. We did not estimate logistic models for K6 $\geq$ 13 because the size of the sample used for regressions decreased to less than 10% (8.8% for men and 9.8% for women). To complete these statistical analyses, we used the Stata data analysis software (version 11; StataCorp).

3. Results

Table 1 summarizes key characteristics of the entire sample over 2005–2010. The mean scores on the K6 were 2.99 for men and 3.43 for women. In addition, 8.3% and 13.9% of male and female respondents, respectively, were providing nursing care to a family member. These observed proportions of caregivers were probably lower than those of the general Japanese population, considering that a substantial proportion of family care is provided by those who are older than the respondents in the surveys (aged 50–64 years). According to the MHLW's nationwide "Comprehensive Survey of the Living Conditions of People on Health and Welfare" conducted in 2010, men and women aged 70 years or above constituted 40.2% and 29.7% of all family caregivers, respectively.

Fig. 1 shows a comparison of K6 scores obtained by caregivers and non-caregivers; these are standardized by sex and age for all the respondents and by age for male and female respondents. Of all the respondents, caregivers obtained higher K6 scores than did non-caregivers ($p < 0.001$), and a similar trend was observed among both genders, confirming a positive association between family care provision and K6 scores. The differences between caregivers' and non-caregivers' K6 scores were significantly higher among women (1.25) than men (0.95), which meant that, when cross-sectional data are used, family caregiving has a more negative association with mental health among women than men.

Table 2 shows a comparison of changes in mean K6 scores between selected groups from the first to the sixth wave of the survey, based on data obtained from 23,621 individuals who participated in all six waves. Of these individuals, we focused on six groups (who provided no caregiving, continued caregiving, started caregiving, increased caregiving, reduced caregiving, and were relieved of caregiving), considering a change in the number of family members that they cared for over the six study waves. We found that those who started caregiving or increased caregiving after the first wave faced a considerably larger increase in K6 scores than any other group. In contrast, only those who provided care in the first wave and had been relieved of it by the sixth wave obtained lower K6 scores. These results suggest a close association between the involvement family caregiving and K6 scores.

Table 1
Key characteristics of the entire sample over 2005–2010.

Variables		All	Men	Women
Age (50–64)	*M*	57.0	57.0	57.0
	SD	3.3	3.3	3.3
Household income	*M*	278.1	330.5	229.3
(Monthly, ＼1000, 2010 prices)	SD	561.2	596.8	521.2
K6	*M*	3.22	2.99	3.43
	SD	4.02	3.94	4.09
Proportion				
Poverty		0.279	0.156	0.394
Working		0.774	0.905	0.652
Unemployed		0.035	0.028	0.041
Inactive		0.191	0.067	0.306
No spouse		0.126	0.110	0.142
Providing nursing care to:				
Any family member		0.112	0.083	0.139
Parents		0.067	0.061	0.073
Father		0.019	0.018	0.021
Mother		0.055	0.049	0.061
Parents-in-law		0.036	0.015	0.056
Father-in-law		0.010	0.005	0.014
Mother-in-law		0.030	0.012	0.047
Others		0.015	0.010	0.019
Co-residing with:				
Parents		0.156	0.234	0.083
Father		0.054	0.084	0.025
Mother		0.140	0.209	0.075
Parents-in-law		0.105	0.056	0.151
Father-in-law		0.034	0.020	0.047
Mother-in-law		0.094	0.050	0.135
Child(ren)		0.561	0.571	0.551
Others		0.672	0.692	0.654
No social activity		0.610	0.616	0.605
N (respondents over 2005–2010)		137,490	66,307	71,183
N (individuals)		26,522	12,646	13,876

Table 3 shows a comparison of the estimated associations of K6 scores, which indicate psychological distress, with family caregiving, socioeconomic and sociodemographic factors, and other individual attributes, using pooled OLS and the fixed-effects regression model for all respondents. The pooled OLS included observed time-invariant variables – dummy variables of female respondents ("1" for females) and each level of educational attainment (with junior high school as a reference) as explanatory variables. These variables were not included in the fixed-effects model because they were removed by mean-centering over time. Both models included year dummy variables for 2006–2010, while the fixed-effects model did not include age, which was linearly dependent on year dummies. We added the interaction term between family caregiving and the female dummies to both models to assess gender bias in the association between caregiving and mental health.

As shown in Table 3, we obtained several noteworthy findings. First, the magnitude of the association of each factor with K6 scores, if significant, was smaller for the fixed-effect model (except for co-residence with a mother-in-law). Notably, the coefficient on nursing care provision in the fixed-effects regression was 0.52, much lower than 0.95 in pooled OLS. This result suggested that insufficient control for unobserved time-invariant characteristics may lead to an overestimated association, presumably because these characteristics affect K6 scores and explanatory variables in the same direction.

Second, there was consistency in some of the results obtained using the two models. K6 scores were positively associated with

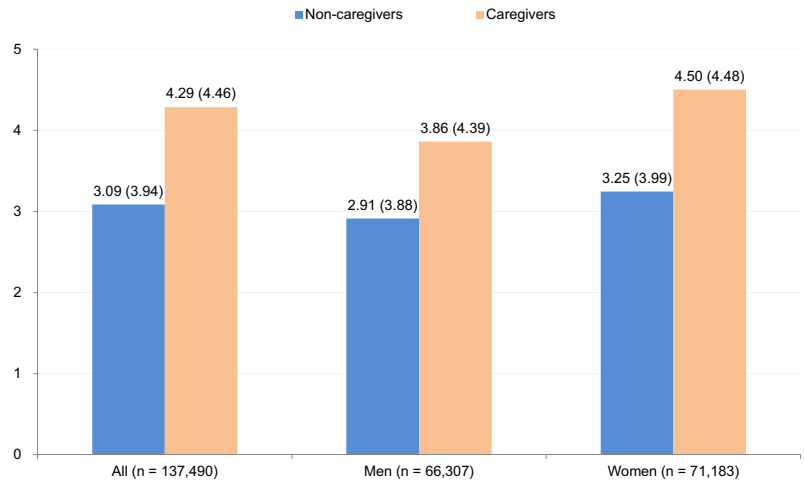

Fig. 1. A comparison of K6 scores (0–24) obtained by nursing caregivers and non-caregivers, based on pooled cross-sectional data. Note: Standardized by sex and age for all respondents, and by age for male and female respondents. Figures in parentheses are standard deviations. Differences in nursing caregivers' and non-caregivers' K6 scores were significant ($p < 0.001$) for all respondents, men, and women.

family care provision, poverty, unemployment, labor force inactivity, no spouse, co-residence with a mother-in-law, and no social activity in both models.

Third, the magnitude of the estimated association with K6 scores was much higher for family caregiving than any socioeconomic or sociodemographic factor in both models. This finding confirmed the relative importance of family caregiving for mental health in adulthood.

Finally, noteworthy differences were observed between the two models with regard to gender effects. The pooled OLS showed a positive and significant coefficient on the interaction between family care provision and being female, as well as the female dummy itself. In contrast, the coefficient on the interaction term was non-significant in the fixed-effects model suggesting that gender did not confound the association between family care provision and mental health.

Table 4 shows the results obtained from the fixed-effect models estimated separately for men and women. We first found that the association between family caregiving and K6 scores was almost similar for men and women, consistent with the non-significant coefficient obtained on the interaction between caregiving and being female, as shown in Table 3. Involvement in family care corresponded with increases of 0.54 and 0.57 in the K6 scores obtained by men and women, respectively. These increases were equivalent to a 0.14 standard deviation of the K6 scores for both genders.

Second, we found that the magnitude of the association between K6 scores and family caregiving was somewhat higher, as compared to that between K6 scores and any socioeconomic or sociodemographic factor. The second–highest association of K6 scores was observed with separation from a spouse (0.39) for men and co-residence with a mother-in-law (0.33) for women.

Third, we noticed asymmetric results between men and women regarding the association between K6 scores and other factors. Although lower household income falling below the poverty line was positively correlated with K6 scores for both men and women, unemployment was of importance to men only. Separation from one's spouse was depressive only for men. Co-residence with any other family member was not associated with men's mental health, while co-residence with a mother-in-law was positively associated with women's K6 scores.

Next, we investigated how kinship between caregivers and care recipients affected the association between caregiving and the caregivers' K6 scores. To examine this effect, we included a binary variable that indicated care provision to each family member in the regression models, in addition to the binary variable that indicated caregiving to any family member. A significant coefficient on this additional binary variable would allude to a kinship-biased association between caregiving and mental health. To highlight the extent to which and the direction in which the association was biased due to kinship, we included respondents who had never experienced caregiving in the regressions, then captured the average association.

Table 5 presents the estimated coefficients on the two binary variables. Each part provides the results of separately estimated fixed-effects regression models (Models I to IV) – in which the dummy variable of care provision to each family member was added – along with those of the benchmark model shown in Table 3 (Model 0) as a reference. The estimation results for other variables were almost unchanged from those in the benchmark model and were not reported due to length constraints.

As shown in Table 5, considerable differences were found between men and women. All the coefficients relating to the additional dummy variables were non-significant among men. Among women, only care provision for a mother-in-law was found to have a positive and significant ($p < 0.001$) association with the K6 score. An additional increase in the K6 score (0.26) among women due to care provision to a mother-in-law was equivalent to 53% of the average increase in the K6 score (0.49) due to family caregiving. No such impact on the association was observed for any other care recipient.

One could argue that these results could be due to the longer hours spent by female caregivers on nursing care provision to their mothers-in-law than any other care recipient. Caregiving hours reported in the survey did not seem sufficiently reliable, as, among other reasons, some caregivers did not report on these. However, based on the responses given, we found that female caregivers spent 18.8 h per week, on average, providing care to their mothers-in-law, somewhat less than the 19.3 h, on average, spent on caring for other family members. In addition, we confirmed that the coefficient obtained for care provision to mothers-in-law remained significant ($p < 0.05$) for female respondents, regardless of the inclusion of the reported hours of caregiving as a dependent variable in the regression models.

Lastly, Table 6 summarizes the estimation results of the fixed-effect logistic regressions to predict a binary variable of psychological distress (K6 $\geq$ 5), exclusively using the data of respondents who experienced a change in K6 scores across the threshold of 5.

Table 2
Changes in K6 scores for selected groups from the first to the sixth wave.

Group	Wave 1 (2005)	Wave6 (2010)	Change in *M*
	M SD	*M* SD	
Provided no caregiving ($n = 17{,}136$)	2.80 (3.78)	3.08 (3.99)	0.28
Continued caregiving ($n = 393$)	4.21 (4.03)	4.76 (4.45)	0.55
Started caregiving after wave 1 ($n = 2228$)	3.19 (4.01)	4.42 (4.64)	1.22
Increased caregiving ($n = 68$)	4.16 (4.02)	5.88 (5.33)	1.72
Reduced caregiving ($n = 132$)	3.95 (3.89)	4.19 (4.06)	0.24
Relieved of caregiving ($n = 1215$)	3.93 (4.19)	3.56 (4.22)	−0.37
All ($n = 23{,}621$)	2.97 (3.86)	3.34 (4.15)	0.37

Note: Based on the data of individuals who participated in all six waves, unadjusted for sex and age. Denoting the number of family members that the respondent cared for in the *k*-th wave by m_k: "Provided no caregiving": $m_1 = \ldots = m_6 = 0$; "Continued caregiving": $m_1, \ldots, m_6 > 0$; "Started caregiving: $m_1 = 0$, $m_6 > 0$; "Increased caregiving": $m_6 > m_1 > 0$; "Reduced caregiving": $m_1 > m_6 > 0$; and "Relieved of caregiving": $m_1 > 0$, $m_6 = 0$.

The results, which were expressed in terms of odds ratios (OR) of K6 scores ≥ 5, were generally consistent with those in Table 4 for continuous K6 scores. The ORs for nursing care provision were highly significant ($p < 0.001$), not different for men and women, and generally higher than those for socioeconomic or sociodemographic factors. We also observed that psychological distress was positively associated with co-residence with a mother-in-law among women, as seen in Table 4, although its association with occupational status and social activity, respectively, proved less significant.

4. Discussion

Previous studies have found a negative association between family caregiving and mental health among middle-aged adults. The current study assessed the validity of this well-established observation by conducting fixed-effects regressions based on nationwide, population-based, six-year panel data. Even after controlling for time-invariant factors – both observed (e.g., gender and educational attainment) and unobserved ones – we confirmed a highly significant and positive association between individuals' involvement in caregiving and K6 scores. It should be noted that this association could be overestimated if time-invariant factors are not sufficiently controlled for, judging by our comparison of the estimation results obtained through pooled OLS and fixed-effects regression models.

Although the findings in the current study did not imply causality, the robustness of the association between family caregiving and mental health was underscored. Some studies have investigated the relationship between mental health and socioeconomic factors in fixed-effects regressions (Andrés, 2004; Lorant et al., 2007; McKenzie et al., 2014). To our knowledge, the current study is one of the first attempting to apply this methodology to the analysis of the association between involvement in family caregiving and mental health.

Moreover, psychological distress in terms of K6 scores was found to be more closely associated with family caregiving than any socioeconomic or sociodemographic factor among both men and women. By jointly considering many factors that were separately addressed in previous studies, the current study revealed that involvement in the provision of nursing care to a family member was the most stressful life event for middle-aged adults in Japan.

The observed negative association between caregiving and mental health was generally consistent with those of preceding studies. Nonetheless, some researchers have found a positive association between caregiving and a caregiver's health (Brown et al., 2009), whereas others found no clear association (Robinson et al., 2009). In addition, the provision of practical or emotional support to family members and friends or, more broadly, altruism, may improve a caregiver's health (Brown et al., 2003). The results of the current study did not support this type of argument, although this could change if we also take into account the extent and length of nursing care, related developments, and the roles played by

Table 3
Estimated associations between independent variables and K6 scores (0–24) for all respondents: A comparison of results from the pooled ordinary least squares (OLS) and fixed-effects models.

$N = 137{,}490$ (26,522 individuals)				
Independent variables	Pooled OLS		Fixed-effects	
	Coef.	95% CI	Coef.	95% CI
Providing nursing care	0.95***	(0.83, 1.08)	0.52***	(0.41, 0.64)
Providing nursing care × Female	0.27***	(0.12, 0.43)	0.08	(−0.07, 0.22)
Female	0.06*	(0.01, 0.11)		–
Graduated from (ref. = Junior high school):				
High school	−0.25***	(−0.32, −0.19)		–
Junior college	−0.23***	(−0.33, −0.13)		–
College or above	−0.35***	(−0.43, −0.28)		–
Age	−0.12***	(−0.13, −0.11)		–
Poverty	0.49***	(0.43, 0.55)	0.14***	(0.09, 0.19)
Unemployed	0.89***	(0.75, 1.03)	0.21***	(0.09, 0.32)
Inactive	0.49***	(0.42, 0.56)	0.21***	(0.12, 0.29)
No spouse	0.62***	(0.55, 0.69)	0.21*	(0.01, 0.42)
Co-residing with:				
Father	0.00	(−0.11, 0.10)	−0.11	(−0.29, 0.07)
Mother	0.06	(−0.02, 0.14)	0.01	(−0.12, 0.15)
Father-in-law	−0.04	(−0.17, 0.09)	−0.05	(−0.25, 0.15)
Mother-in-law	0.10*	(0.01, 0.18)	0.20**	(0.05, 0.35)
Child(ren)	−0.06	(−0.14, 0.03)	0.03	(−0.08, 0.13)
Others	0.08	(−0.01, 0.18)	0.01	(-0.11, 0.13)
No social activity	0.34***	(0.30, 0.38)	0.07**	(0.02, 0.11)

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.
Year dummies for 2006–2010 were included in the estimation. Attrition bias was controlled for through inverse probability weighting.

Table 4
Estimated associations between independent variables and K6 scores (0–24) by gender: Fixed-effects regressions.

Independent variable	Men (n = 66,307) [12,646 individuals]		Women (n = 71,183) [13,876 individuals]	
	Coef.	95% CI	Coef.	95% CI
Providing nursing care	0.54***	(0.44, 0.64)	0.57***	(0.49, 0.66)
Poverty	0.21***	(0.13, 0.29)	0.11***	(0.05, 0.16)
Unemployed	0.33***	(0.16, 0.50)	0.11	(−0.01, 0.24)
Inactive	0.34***	(0.19, 0.48)	0.13**	(0.04, 0.22)
No spouse	0.39**	(0.13, 0.66)	0.09	(−0.15, 0.34)
Co-residing with:				
Father	−0.11	(−0.29, 0.07)	−0.13	(−0.44, 0.18)
Mother	−0.02	(−0.16, 0.12)	0.04	(−0.17, 0.25)
Father-in-law	0.12	(−0.20, 0.45)	−0.09	(−0.31, 0.12)
Mother-in-law	−0.08	(−0.31, 0.14)	0.33***	(0.17, 0.49)
Child(ren)	0.10	(−0.03, 0.23)	−0.05	(−0.19, 0.09)
Others	−0.08	(−0.22, 0.06)	0.11	(−0.04, 0.26)
No social activity	0.06*	(0.00, 0.12)	0.07**	(0.02, 0.12)

Note: Year dummies for 2006–2010 were included in the estimation. Attrition bias was controlled for through inverse probability weighting.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

caregivers in the family context and society. Moreover, public care provision and support for family caregiving could possibly moderate the negative impact of caregiving on mental health (Robison et al., 2009).

The fact that family caregivers experience serious psychological distress has important implications for social policies. Policy measures aimed at mitigating the psychological and physical burdens carried by family caregivers should be reconsidered. This is especially true if caregiving at home increases the risk of individuals losing their jobs, thereby lowering their income. A combination of these factors could amplify a negative impact on mental health. The public LTCI or long-term care insurance system was initiated to relieve the burden carried by family caregivers in Japan; however, the effectiveness thereof is hampered by the lack of support received by family caregivers (Tamiya et al., 2011).

Most of the findings in the current study were consistent with those of previous studies. A negative association was found between psychological distress and lower socioeconomic status,

Table 5
Estimated associations between nursing care provision and K6 scores (0–24) by kinship between caregivers and care recipients: Fixed-effects regressions.

Model:	Providing nursing care to:	Men (n = 66,307) [12,646 individuals]		Women (n = 71,183) [13,876 individuals]	
		Coef.	95% CI	Coef.	95% CI
0	Any family member	0.54***	(0.44, 0.64)	0.57***	(0.49, 0.66)
I	Any family member	0.55***	(0.44, 0.66)	0.55***	(0.46, 0.63)
	Father	−0.04	(−0.26, 0.18)	0.19	(−0.02, 0.40)
II	Any family member	0.46***	(0.32, 0.60)	0.57***	(0.47, 0.67)
	Mother	0.15	(−0.06, 0.33)	0.01	(−0.14, 0.17)
III	Any family member	0.55***	(0.44, 0.65)	0.57***	(0.48, 0.65)
	Father-in-law	−0.07	(−0.42, 0.28)	0.10	(−0.14, 0.34)
IV	Any family member	0.56***	(0.45, 0.67)	0.49***	(0.40, 0.59)
	Mother-in-law	−0.09	(−0.33, 0.14)	0.26**	(0.10, 0.43)
V	Any family member	0.53***	(0.43, 0.64)	0.57***	(0.48, 0.66)
	Others	0.06	(−0.25, 0.36)	0.04	(−0.16, 0.25)

Note: Each part provides the results of separately estimated fixed-effects regression models, in which the dummy variable of care provision to each family member was added. Results of other variables were not reported due to length constraints. Attrition bias was controlled for through inverse probability weighting.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Table 6
Estimated associations between independent variables and psychological distress (K6 $\geq$ 5) by gender: Fixed-effects logistic regressions.

Independent variable	Men (n = 26, 604) [5624 individuals]		Women (n = 30, 437) [6381 individuals]	
	OR	95% CI	OR	95% CI
Providing nursing care	1.58***	(1.40, 1.78)	1.58***	(1.43, 1.74)
Poverty	1.25***	(1.14, 1.37)	1.09**	(1.02, 1.17)
Unemployed	1.17	(0.97, 1.40)	1.00	(0.86, 1.16)
Inactive	1.17*	(1.00, 1.37)	1.12	(1.00, 1.25)
No spouse	1.46*	(1.07, 1.98)	1.10	(0.88, 1.38)
Co-residing with:				
Father	0.92	(0.74, 1.15)	0.90	(0.64, 1.26)
Mother	0.97	(0.81, 1.16)	1.15	(0.91, 1.47)
Father-in-law	0.82	(0.54, 1.25)	0.86	(0.66, 1.12)
Mother-in-law	0.94	(0.71, 1.24)	1.47***	(1.22, 1.77)
Child(ren)	1.10	(0.93, 1.29)	0.97	(0.82, 1.14)
Others	0.99	(0.83, 1.18)	1.12	(0.94, 1.34)
No social activity	1.03	(0.95, 1.11)	1.03	(0.96, 1.10)

Note: Year dummies for 2006–2010 were included in the estimation.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

which is demonstrated by lower household income and job loss. We also obtained gender-asymmetric findings. Notably, separation from a spouse was negatively associated only with men's mental health, whereas co-residence with a mother-in-law mattered only for women.

Furthermore, we found that the association between family care provision and mental health was not similar for men and women. Female caregivers experienced additional distress when providing nursing care to their mothers-in-law. In their study, Nishi et al. (2010) showed that older Japanese women experience faster deterioration in health when cared for by their daughters-in-law. Hence, we can argue that care provision by daughters-in-law to their mothers-in-law has negative effects on both parties. The amplifying effect of the possibly strained relations between mothers-in-law and daughters-in-law on the mental health of female caregivers should be studied further.

The current study had several limitations, in addition to potential biases resulting from missing data and possible overestimation of poverty. First, the observed associations of mental health with family caregiving and other factors did not indicate any causality. For example, we cannot rule out the possibility that deteriorating mental health led to unemployment and economic strain. Second, we did not examine the relationships between the independent variables. For example, adult children could decide to reside with their parents or parents-in-law due to the need to provide nursing care to them. Thirdly, there are several aspects that the binary variables of involvement in nursing care could not capture; these include the extent and length of nursing care and developments in this regard over the six waves of the study. Lastly, the potential of the public service provided under the LTCI system in helping family caregivers had yet to be discussed, due to the limitations imposed by the data obtained. These issues should be addressed in future research.

5. Conclusions

This study demonstrated that the mental health of middle-aged Japanese adults is negatively associated with involvement in family caregiving. The study used data obtained from a nationwide, population-based, six-year survey, with time-invariant factors controlled for. Psychological distress was more significantly associated with family caregiving than any socioeconomic and sociodemographic factor that the respondents were exposed to in midlife. Care provision to a mother-in-law had an additional, negative association with mental health for female caregivers, as opposed to men. These findings suggest that more panel studies are needed to examine the correlates of mental health among middle-aged adults.

Ethics approval/Statement

We used six-year panel data from a nationwide population-based survey, "The Longitudinal Survey of Middle-aged and Older Adults," conducted and released by the Japanese Ministry of Health, Labour and Welfare (MHLW) between 2005 and 2010. Hence, ethics approval is not required for this paper.

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