

# How is an informal caregiver's psychological distress associated with prolonged caregiving? Evidence from a six-wave panel survey in Japan

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## Abstract

**Purpose** The provision of informal nursing care can adversely affect a caregiver's mental health, but the dynamic association of the variables is still under debate. We examined how an informal caregiver's psychological distress is associated with prolonged caregiving.

**Methods** We used data collected from a nationwide six-wave panel survey in Japan, with 25,186 observations of 9192 individuals. We focused on informal caregivers, who provided help and support for ill family members. We used Kessler 6 (K6) scores (range 0–24), where higher scores reflect higher levels of psychological distress. We employed mixed-effects models to examine how caregivers' psychological distress was associated with caregiving commencement and duration.

**Results** Commencement of caregiving raised the K6 score for female caregivers by 0.55 (equivalent to 0.12 SD, 95 % CI 0.34–0.75) and that for male caregivers by 0.41 (0.09 SD, 95 % CI 0.18–0.63). However, prolonged caregiving had gender-asymmetric, dynamic associations with psychological distress. One additional year of caregiving added 0.22 (0.05 SD, 95 % CI 0.10–0.35) to the K6 score of female caregivers, while it had no significant association for male caregivers. For female caregivers, prolonged caregiving was positively associated with K6 score entirely through its interaction effects with longer hours of care, co-residence with a care recipient, and the non-working status of a caregiver.

**Conclusions** Results revealed a gender-asymmetric, dynamic association between informal care provision and

caregivers' psychological distress. Additional policy measures targeted at caregivers deeply involved in in-house care are needed to reduce their distress.

**Keywords** Informal caregiving · Caregiver · Psychological distress · Kessler 6 scores · Japan

## Introduction

Informal caregiving adversely affects a caregiver's mental health [1–3], but the dynamic association between these two variables is still under debate. It is reasonable to argue that a longer duration of caregiving tends to add to a caregiver's psychological distress and that many studies have provided observations supporting this view [4–8]. Conversely, one may argue that a caregiver's mental health tends to stay relatively stable over time, as suggested by adaptation theory [9, 10]. Individuals may adapt to a negative shock related to caregiving over time, even if they are strongly affected by it when it occurs initially. Some studies have supported this adaptation theory [11, 12].

Moreover, the association between prolonged caregiving and a caregiver's mental health is likely confounded by several factors. Indeed, studies have shown that women are more inclined to exhibit adverse mental health outcomes compared to men [4, 13, 14] and that spousal caregivers tend to report lower levels of psychological well-being compared to other family caregivers [15, 16]. More broadly, various care-rated confounders—both time-variant and time-invariant—may potentially affect the evolution of a caregiver's mental health.

In the current study, we examined how a caregiver's mental health in terms of psychological distress evolves at

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the start of caregiving and over subsequent years and what factors affect its dynamics. In addition to using a large-scale, nationwide six-wave survey (with 25,186 observations of 9192 individuals), the current study had three features that were expected to provide new insights into the association between informal caregiving and caregivers' mental health.

First, we employed mixed-effects models to examine the evolution of caregivers' psychological distress over time [4, 17]. For longitudinal analysis of caregivers' mental health or subjective well-being, many studies have used fixed-effects models [18, 19]. Studies using these models controlled for time-invariant confounders at the caregiver level and focused on variations within caregivers. In contrast, mixed-effects models in the current study allowed for the study of variations both within and between caregivers [20, 21]; mixed-effect models consist of both fixed effects (intercepts and slopes of the regression line describing the evolution of psychological distress over time for caregivers as a whole) and random effects (intercepts and slopes that can vary across caregivers). We believe that mixed-effects models can more precisely track the changes in psychological distress than can fixed-effects models, considering that the changes in psychological distress are likely to differ across caregivers.

Second, we examined how various care-related variables confounded the association between the caregiving duration and caregivers' psychological distress, an issue largely understudied in the past. We cannot rule out the possibility that an observed association between prolonged caregiving and caregiver distress is attributable to the interaction effects between caregiving duration and other care-related variables. Without controlling for these interaction effects, we cannot assess the importance of caregiving duration for a caregiver's mental health or design effective policy measures to support informal caregiving.

Third, we used microdata from a nationwide survey in Japan. Japan is characterized by multigenerational family settings [22], and considerable importance is attached to informal caregiving in long-term care for the elderly. Recent statistics show that more than 70 % of nursing care is still provided at home, and mainly by women in 2013 [23], despite the fact that, in 2000, a public long-term care insurance (LTCI) system was initiated to relieve family caregivers of the burdens associated with their roles [24]. It is of great interest to examine to what extent the observations obtained from the preceding studies conducted mostly in the USA, Europe, and other Western countries are valid for the Japanese data. An increasing number of studies have been examining longitudinal changes in the mental health of Japanese caregivers. However, most of them have used community or small convenience samples and/or only two or three waves [25–27], making any generalization or cross-country comparison difficult.

## Methods

### Study sample

We used six-wave panel data obtained from a nationwide, population-based survey, "The Longitudinal Survey of Middle-Aged and Older Adults". The survey was conducted by the Japanese Ministry of Health, Labour and Welfare (MHLW) each year between 2005 and 2010. Samples in the first wave were collected nationwide in November 2005 through a two-stage random sampling procedure. The questionnaires were physically distributed to the participants' homes, where they were completed by November 2, and physically collected several days later. A total of 34,240 individuals responded (response rate: 83.8 %). The second to sixth waves of the survey were conducted in early November in each year from 2006 to 2010 and consisted of 32,285 (2006), 30,730 (2007), 29,605 (2008), 28,736 (2009), and 26,220 (2010) respondents (response rate: 91.8–97.3 %). No new respondents were added after the first wave.

After excluding the respondents who were missing key variables, we used two sample subsets, which were not exclusive with each other, for two different research purposes. The first subset consisted of respondents who had not cared for any family member 1 year before, in order to examine how caregiving commencement was associated with psychological distress. We excluded those who had cared for any family member 1 year before, because this meant that they had already started caregiving before the survey year or had stopped caregiving at that time.

We constructed the second subset from respondents who started caregiving between 2006 and 2010, in order to examine how the duration of caregiving was associated with psychological distress. We excluded (1) those who had already started caregiving in 2005 because we could not identify when they had started it and (2) those who had no experience in caregiving between 2006 and 2010 because they were irrelevant for the current analysis.

These two subsets comprised 15,994 observations (of 5437 individuals) and 9192 observations (of 5084 individuals), respectively. Six hundred and thirty and 11 individuals started caregiving twice and three times, respectively, between 2006 and 2010.

### Measures

#### *Psychological distress*

We used Kessler 6 (K6) scores to measure psychological distress [28, 29]. The reliability and validity of this tool have been demonstrated for a Japanese sample [30, 31]. First, we obtained the respondents' assessments of

psychological distress using the six items of the K6 scale, which were as follows: “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?” These items are rated on a 5-point scale, from 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 this as the K6 score. Higher K6 scores indicate higher levels of psychological distress. The Cronbach’s alpha coefficient for this sample was 0.894.

### *Family caregiving*

The survey included items related to respondents’ caregiving of family members 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, and 18.3 % in the first wave became newly involved in caregiving during the second and sixth waves.

We used two variables to indicate caregiving status. The first was a binary variable to which we allocated a “1” if the respondent started providing care to at least one family member, regardless of their living arrangements. It should be remembered that we excluded those who had provided care 1 year before. The second was a continuous variable of years (from 0 to 4) after the start of caregiving, with “0” indicating caregiving commencement.

We further considered four care-related factors, which have been found to confound the association between prolonged caregiving and caregivers’ mental health in preceding studies. First, we considered a caregiver’s hours of care, because more hours devoted to family caregiving may be more likely to have an adverse impact on a caregiver’s mental health [32]. The survey asked respondents how many hours they spent on caregiving per week. We constructed a binary variable to which we allocated a “1” if the respondent answered that he or she spent 14 h or more per week (i.e. 2 h or more per day on average) on family caregiving, which comprised 29.3 % of all caregivers.

Second was co-residence with a care recipient. Japanese society is characterized by multigenerational family settings, which may affect the psychological distress of each family member [22]. The study sample in the current study consisted of middle-aged adults, who had many chances to reside with their parents or parents-in-law. We constructed a binary variable for co-residence with a care recipient at the wave of study. It is predicted that co-residence makes caregivers heavily involved in family care, thereby amplifying psychological distress related to longer caregiving durations.

Third was the kin relationship with a care recipient. Studies have shown that spousal caregivers tend to report

lower levels of psychological well-being compared to other family caregivers [15, 16], and that, in Japan, the kin relationship with a recipient confounds the association between caregiving and a caregiver’s mental health [18, 26]. We constructed four binary variables to which we allocated a “1” if the respondent cared for each of the four types of family members: spouse, parent(s), parent(s)-in-law, and others and a “0” otherwise.

Lastly, we focused on a caregiver’s working status, which appears to link indirectly to his/her involvement in family care. One of the major purposes of introducing LTCI in Japan was to relieve family caregivers of the burdens associated with their roles [22]. We interpreted the undertaking of paid work as an indicator of the caregiver having a high degree of freedom in daily activities; this is a reasonable assumption, given that we controlled for household income (see below). We constructed a binary variable to which we allocated a “1” if the respondent was not employed in any paid job and a “0” otherwise.

### *Covariates*

We regarded household income as a key socio-economic factor closely related to psychological distress. We 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 by the Organisation for Economic Co-operation and Development [33, 34]. We categorized this household-size-adjusted income into quartiles. We also controlled for educational attainment by dividing respondents into three categories: graduated from junior high school, high school, and college or over (where junior college was treated as college). With regard to socio-demographic factors, we constructed a binary variable relating to marital status (married) and used age as a continuous variable. Finally, we included binary variables for each wave to control for wave-specific factors.

### *Estimation strategy*

We estimated five regression model types: Models 1–5. Model 1 examined how a caregiver’s psychological distress was associated with caregiving commencement, while Models 2–5 examined how it evolved over the subsequent years. For both regression analyses, we used linear mixed-effects models, which considered both fixed and random effects.

Specifically, Model 1 estimated the K6 score by (1) caregiving commencement, (2) non-working status, (3) covariates, and (4) the K6 score 1 year before caregiving commencement, by allowing caregiver-variant random

intercepts and slopes. We included the K6 score 1 year before caregiving commencement as a regressor to control for its baseline level.

Then, we shifted our attention to respondents who had commenced caregiving 1 year before. Model 2 estimated the K6 score by (1) years after caregiving commencement (from 0 to 4), (2) non-working status, (3) covariates, and (4) the K6 score at caregiving commencement, by allowing for caregiver-variant random intercepts and slopes. The estimated coefficient on years indicates how much one additional year of caregiving raised the K6 score on average. We included the K6 score at the start of caregiving as its baseline level.

To Model 2, Model 3 added the care-related binary variables of hours of care (>14 h per week), residing with a care recipient, and caring for a spouse, parent(s)-in-law, and others (using caring for parent(s) as a reference). The key focus in this model was on whether these care-related variables significantly affected the level (i.e. intercept) of the K6 score.

The estimated coefficient on years after caregiving commencement in Models 2 and 3 would indicate its mean association with the K6 score for caregivers as a whole. In Model 4, we included the interaction terms of years with the six care-related variables. We examined how these variables affected the association (i.e. slope) between the caregiving duration and K6 score, based on the sign and significance of their coefficients. For example, if we observed a positive coefficient on the interaction term with non-working status, we can argue that non-working status makes a prolonged duration of caregiving more distressful for caregivers.

However, the results in Model 4 would not demonstrate which variable would account for any observed positive association between prolonged caregiving and the K6 score, because this model included all interaction terms simultaneously. To address this issue, we ran Models 5a–f, which included each interaction term separately.

We ran all of these models separately for women and men to examine gender differences. To complete these statistical analyses, we used the Stata data analysis software (version 13; StataCorp).

## Results

### Descriptive analysis

Table 1 summarizes the basic characteristics of caregivers in the study sample. We observed that, in general, women were more heavily involved in family caregiving compared to men; female caregivers spent more hours on caregiving, and a much higher proportion of female caregivers were

not working compared to male caregivers. We also found that there were fewer female and male caregivers when the caregiving duration was longer.

### Regression analysis

Table 2 summarizes the estimation results obtained from Model 1 to capture how the K6 responded to caregiving commencement. Caregiving commencement increased the K6 scores for both genders, recording 0.55 (equivalent to 0.12 SD, 95 % CI 0.34–0.75) and 0.41 (0.09 SD, 95 % CI 0.18–0.63) for women and men, respectively. We also noticed that non-working status was positively associated with the K6 score.

Table 3 presents the main results of the current study for women (top part) and men (bottom). This table demonstrates a number of important points. First, Model 2, which controlled for basic socio-demographic covariates only, showed that one additional year of caregiving raised the K6 score by 0.23 (0.05 SD, 95 % CI 0.11–0.35) for women, while it did not lead to any significant change for men.

We also found from that the coefficients on years remained virtually unchanged even after adding care-related variables for both genders in Model 3. This indicates that a marginal association (i.e. slope) between the duration and K6 scores was not impacted by their effects. However, it should be noted that the estimated slope of the duration in Models 2 and 3 indicates the mean value for caregivers as a whole.

Then, we added the interaction terms of years with care-related variables in Model 4, which yielded substantial changes from Model 3. Most notably, the interaction terms with hours of care (>14 h per week), residing with a care recipient, caring for a spouse, and not working had significant, positive coefficients for women only. Combined with the coefficient on duration becoming insignificant, these results suggest that prolonged caregiving had a positive association with a female caregiver's K6 score entirely through its interaction with these care-related variables. In contrast, results for male caregivers were not affected by adding the interaction terms.

Table 4 presented the estimated coefficients on duration and each interaction term obtained from Models 5a–f. We first noticed (as shown in the top part of Table 4) that adding each interaction term with hours of care ( $\geq 14$  h per week), residing with a care recipient, and not working made the coefficient on duration insignificant, while the coefficients on these interaction terms were positive and significant. This result, which was consistent with that in Model 4, suggests that these care-related variables were necessary conditions for a positive association between prolonged caregiving and a female caregiver's K6 score.

We also found from the bottom part of the table that caring for a spouse amplified the association between the

**Table 1** Basic characteristics of caregivers

	Women	Men	All
<i>Number</i>			
Caregiving commencement	3181	2243	5424
1 year after commencement	1323	772	2095
2 years after commencement	674	357	1031
3 years after commencement	315	158	473
4 years after commencement	114	55	169
<i>Percentage</i>			
Hours of care $\geq 14$ h per week	33.1	23.2	29.3
Residing with a care recipient	48.0	58.7	52.2
Caring for a spouse	3.5	2.6	3.2
Parent(s)	54.3	70.3	60.5
Parent(s)-in-law	37.8	22.0	31.6
Others	10.6	9.1	10.0
Not working	40.8	14.1	30.4
Graduated from junior high school	10.4	12.4	10.8
High school	62.4	51.1	58.0
Junior college	15.8	2.9	10.8
College or above	10.8	32.8	19.4
Married	88.3	89.2	88.7
<i>M and (SD)</i>			
Household income (million yen)	285.4 (572.8)	333.9 (722.7)	304.3 (635.9)
Age	57.7 (3.0)	58.1 (2.9)	57.8 (3.0)
Hours of care per week	2.41 (3.90)	1.79 (3.37)	2.17 (3.72)
<i>N</i>	5607	3585	9192

**Table 2** Associations between the start of caregiving and K6 score, obtained from linear mixed-effects models: Model 1<sup>a</sup>

	Women		Men	
	Coefficient	95 % CI	Coefficient	95 % CI
Caregiving commencement	0.55***	(0.34, 0.75)	0.41***	(0.18, 0.63)
Not working	0.34***	(0.19, 0.47)	0.44***	(0.19, 0.69)
Household income: 1st quartile	0.42**	(0.11, 0.72)	0.10	(−0.26, 0.46)
2nd quartile	0.17	(−0.14, 0.48)	0.11	(−0.24, 0.47)
3rd quartile	−0.19	(−0.49, 0.12)	−0.04	(−0.37, 0.30)
Graduated from junior high school	0.10	(−0.15, 0.22)	0.34*	(0.05, 0.63)
High school	−0.18	(−0.40, 0.05)	−0.04	(−0.23, 0.16)
Married	−0.18	(−0.17, 0.37)	−0.52***	(−0.80, 0.24)
Age	−0.08***	(−0.11, −0.06)	−0.02	(−0.05, 0.01)
K6 score 1 year before caregiving commencement	0.70***	(0.68, 0.72)	0.69***	(0.67, 0.71)
<i>N</i>	9048	(3150 individuals)	6946	(2287 individuals)

\*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$

<sup>a</sup> Allowed caregiver-varying random intercepts and slopes and controlled for survey years

caregiving duration and K6 score; however, it kept the coefficient on the year positive and significant, presumably due to a limited proportion of those who were caring for a spouse (3.5 %; see Table 1), which reflected the relatively

young sample. Finally, the interaction terms with caring for a parent(s)-in-law and others did not have any significant coefficient and kept the coefficient on the year positive and significant, suggesting their limited interaction effects.

**Table 3** Associations between caregiving duration and K6 score, obtained from linear mixed-effects models: Models 2–4<sup>a</sup>

	Model 2		Model 3		Model 4	
	Coefficient	95 % CI	Coefficient	95 % CI	Coefficient	95 % CI
<i>Women (N = 5607 [2993 individuals])</i>						
Years after caregiving commencement	0.23***	(0.11, 0.36)	0.22***	(0.10, 0.35)	−0.02	(−0.21, 0.18)
×Hours of care (>14 h per week)					0.19*	(0.04, 0.33)
×Residing with a care recipient					0.22*	(0.01, 0.44)
×Caring for a spouse					0.59*	(0.10, 1.08)
×Caring for a parent(s)-in-law					−0.15	(−0.38, 0.08)
×Caring for others					−0.12	(−0.43, 0.19)
×Not working					0.22*	(0.03, 0.42)
Hours of care (>14 h per week)			0.24***	(0.12, 0.36)	0.17*	(0.04, 0.30)
Residing with a care recipient			0.09	(−0.04, 0.21)	0.04	(−0.08, 0.18)
Caring for a spouse			0.22	(−0.12, 0.55)	0.06	(−0.30, 0.41)
Caring for parent(s)-in-law			0.03	(−0.10, 0.16)	0.05	(−0.06, 0.25)
Caring for others			−0.04	(−0.21, 0.14)	0.01	(−0.18, 0.20)
Not working	0.05	(−0.07, 0.16)	0.02	(−0.09, 0.14)	−0.03	(−0.15, 0.09)
K6 score at caregiving commencement	0.89***	(0.88, 0.90)	0.88***	(0.87, 0.89)	0.88***	(0.87, 0.90)
<i>Men (N = 3585 [2091 individuals])</i>						
Years after caregiving commencement	0.09	(−0.11, 0.28)	0.09	(−0.10, 0.28)	0.13	(−0.13, 0.39)
×Not working					−0.29	(−0.60, 0.02)
×Hours of care (>14 h per week)					0.15	(−0.03, 0.33)
×Residing with a care recipient					−0.04	(−0.29, 0.21)
×Caring for a spouse					0.08	(−0.72, 0.88)
×Caring for a parent(s)-in-law					−0.05	(−0.23, 0.33)
×Caring for others					−0.25	(−0.67, 0.16)
Hours of care (>14 h per week)			−0.01	(0.14, 0.12)	−0.06	(−0.20, 0.08)
Residing with a care recipient			0.06	(−0.06, 0.17)	0.07	(−0.05, 0.19)
Caring for a spouse			−0.18	(−0.56, 0.21)	−0.19	(−0.59, 0.21)
Caring for parent(s)-in-law			0.07	(−0.07, 0.20)	0.06	(−0.08, 0.20)
Caring for others			0.06	(−0.13, 0.25)	0.09	(−0.10, 0.29)
Not working	−0.05	(−0.22, 0.13)	−0.04	(−0.22, 0.13)	0.01	(−0.17, 0.19)
K6 score at caregiving commencement	0.91***	(0.90, 0.93)	0.91***	(0.90, 0.93)	0.91***	(0.90, 0.93)

\*\*\*  $p < 0.001$ ; \*  $p < 0.05$

<sup>a</sup> Allowed caregiver-varying random intercepts and slopes and controlled for age, marital status, educational attainment, household income, occupational status, and survey years (see Table 2)

## Discussion

We have examined the dynamic association between informal caregiving and a caregiver's psychological distress, which is an issue still under debate. We applied mixed-effects models, which allowed variations both within and between caregivers, to a large dataset from a nationwide six-wave survey in Japan. We focused on psychological distress as measured by the K6 score and considered various care-related variables that would potentially confound its association with caregiving duration. The main findings and their implications are summarized as follows.

First, we found substantial gender differences in the dynamic association between caregiving and a caregiver's psychological distress. While the start of caregiving increased psychological distress for both female and male caregivers, its evolution over the subsequent years exhibited substantial gender differences. A longer duration of caregiving raised female caregivers' distress, but not the distress of male caregivers, which is consistent with previous studies showing that women are more inclined to exhibit adverse mental health outcomes compared to men [4, 13, 14].

Two points should be mentioned regarding these gender differences. First, one may suspect that men's limited

**Table 4** The effects of care-rated factors on the association between caregiving duration and K5 scores of female caregivers, obtained from separately estimated linear mixed-effects models: Models 5a–f<sup>a</sup>  $N = 5607$  [2993 individuals]

	Model 5a		Model 5b		Model 5c	
	Coefficient	95 % CI	Coefficient	95 % CI	Coefficient	95 % CI
Years after caregiving commencement	0.13	(−0.01, 0.27)	0.10	(−0.06, 0.26)	0.12	(−0.03, 0.27)
×Hours of care ( $\geq 14$ h per week)	0.23**	(0.09, 0.38)				
×Residing with a care recipient			0.24*	(0.05, 0.44)		
×Not working					0.24*	(0.05, 0.44)
	Model 5d		Model 5e		Model 5f	
	Coefficient	95 % CI	Coefficient	95 % CI	Coefficient	95 % CI
Years after caregiving commencement	0.19**	(0.06, 0.32)	0.26***	(0.11, 0.41)	0.23**	(0.10, 0.36)
×Caring for a spouse (husband)	0.78***	(0.31, 1.25)				
×Caring for a parent(s)-in-law			−0.09	(−0.30, 0.12)		
×Caring for others					−0.11	(−0.40, 0.19)

\*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$

<sup>a</sup> Allowed caregiver-varying random intercepts and slopes and controlled for age, marital status, educational attainment, household income, occupational status, and survey years as well as caregiving-rated variables (see Table 4)

sensitivity to caregiving duration is explained by differences in the depth of involvement of care between women and men. In particular, it might be possible that male caregivers were often helped more by their spouse and/or other family members compared to female caregivers. Unfortunately, any information about other family members' help in the respondent's caregiving was not available from the study survey. Thus, we estimated Models 2–4 for male caregivers who resided with their care recipients only, and obtained an insignificant association between caregiving duration and the K6 score again (estimation results are available upon request). This confirms the robustness of the results for men, as shown in Tables 2, 3, and 4, which supports the adaptation hypothesis for male caregivers.

However, the second point is that the observed strong association between caregiving duration and a female caregiver's K6 score does not necessarily mean that women had a poorer ability to adapt to stress caused by prolonged caregiving compared to men. After controlling for the interaction effects of the duration with care-related variables—specifically, long hours of care, co-residence with a care recipient, and non-working status—prolonged caregiving was not associated with a female caregiver's distress.

The stress-and-coping models of caregiving suggest that gender differences in caregiver health can be explained by gender differences in caregiver variables and resources [13, 14]. The results in the current study did not contradict these models in that the association between the duration and distress was insignificant for both genders after controlling for care-related variables. However, given that no care-related variable affected the association for male

caregivers, we should be cautious in concluding that the stress-and-coping models can explain the observed gender differences. We should further investigate why Japanese male caregivers were so insensitive to care-related variables once they started caregiving, when more detailed information about caregiving becomes available.

Another noteworthy finding was that a positive association between prolonged caregiving and female caregivers' distress was accounted for by the interaction effects of prolonged caregiving and several care-related variables: longer hours of care, co-residence with a care recipient, and non-working status. These results confirm the validity of the observations and their implications from previous studies: (1) longer hours of care and caring for a spouse have been found to be key correlates of caregivers' mental health in preceding studies [15, 16]; (2) the stressful aspect of co-residence with a care recipient was of great importance for multigenerational family settings in Japan [22]; and (3) the psychological burden of non-working status was consistent with the observation that engaging in productive roles has psychological benefits [35].

The results have valuable implications for policy support to informal caregivers. We confirmed that the sensitivity of psychological distress to prolonged caregiving crucially depends on the depth of involvement in caregiving, particularly for female caregivers. We observed a deteriorating trend of a caregiver's psychological distress after caregiving commenced. However, the finding that it was largely attributable to interactions with other care-related variables implies that these other variables are more important determinants of a caregiver's psychological distress than the duration itself.

Hence, we can argue that great emphasis should be placed on policies to reduce the socio-economic and psychological burdens of caregivers who are heavily involved in providing care to co-residing family members. To this end, policy measures such as providing a wider range of home-visit nursing care services to in-house care recipients and expanding institutional care services could be effective. In addition, caregivers' mental health should be regularly checked, especially if their caregiving is prolonged. At the same time, our results highlighted the complexity of the conditions surrounding caregivers' mental health, suggesting that success with these policy measures would be hard-won.

We recognize that this study has several limitations. First of all, we should be cautious in generalizing the obtained results, which were based on Japanese data, although we found several results largely similar to those obtained from previous studies using data in Western countries. Regarding the data, the results were not free from potential biases and limited reliability, mostly because of self-reported nature of the respondents' answers. This may be especially the case for certain responses (e.g. hours of care) from caregivers who were heavily involved in caregiving and/or felt highly distressed. In addition, the results were likely influenced by attrition bias. A total of 23.4 % of the initial respondents dropped out of the sample during the six waves, resulting in an average attrition rate of 4.7 % per year. While this was relatively low, the estimated association between caregiving duration and psychological distress was probably underestimated.

In terms of the analytic methodology, the first limitation was that we did not take into account the formal and informal support provided to family caregiving due to the limited data available. Caregivers can receive formal support from the LTCI programs, depending on the nursing care level of care recipients, and they may obtain support from other family members or others (e.g. friends). Any observed association between caregiving duration and a caregiver's psychological distress is likely confounded by such support. Second, we did not fully control for simultaneity and endogeneity among the variables. Many caregivers make simultaneous decisions about caregiving, living arrangements, and work status, meaning that one decision affects and is affected by others. Changes in psychological distress during care provision may change caregivers' behaviours, which were assumed to be given for exogenous reasons. Third, we exclusively considered the negative aspects of informal caregiving for caregivers' mental health, despite the fact that studies have found that informal caregiving has both negative and positive effects on caregivers' health outcomes [36, 37]. These issues should be addressed in future research.

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**Ethical standard** All procedures performed in studies involving human participants were in accordance with the ethical standards of the national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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