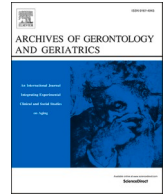Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Association between family caregivers and depressive symptoms among community-dwelling older adults in Japan: A cross-sectional study during the COVID-19 pandemic

Taiji Noguchi [a,b,*], Takahiro Hayashi [c], Yuta Kubo [c], Naoki Tomiyama [c], Akira Ochi [c], Hiroyuki Hayashi [c]

[a] Department of Social Science, Center for Gerontology and Social Science, National Center for Geriatrics and Gerontology, Aichi, Japan
[b] Department of Public Health, Nagoya City University Graduate School of Medical Sciences, Aichi, Japan
[c] Department of Rehabilitation and Care, Seijoh University, Aicihi, Japan

ARTICLE INFO

ABSTRACT

Objectives: Novel coronavirus disease (COVID-19) pandemic could increase the mental health burden of family caregivers of older adults, but related reports are limited. We examined the association between family caregiving and changes in the depressive symptom status during the pandemic.

Methods: This cross-sectional study included 957 (mean age [standard deviation] = 80.8 [4.8] years; 53.5% females) community-dwelling older adults aged $\geq$ 65 years from a semi-urban area of Japan, who completed a mailed questionnaire. Based on the depressive symptom status assessed with the Two-Question Screen between March and October 2020, participants were classified into four groups: "non-depressive symptoms," "incidence of depressive symptoms," "remission from depressive symptoms," or "persistence of depressive symptoms." Participants were assessed in October 2020 for the family caregiving status, caregiving role, the severity of care recipients' needs, and increased caregiver burden during the pandemic, each with the simple question. Multinomial logistic regression analysis was applied to obtain the odds ratios (ORs) and 95% confidence intervals (CIs) for changes in depressive symptom status.

Results: Compared to non-caregivers, family caregivers were associated with the incidence (OR [95% CI] = 3.17 [1.55–6.51], $p < 0.01$) and persistence of depressive symptoms (OR [95% CI] = 2.39 [1.30–4.38], $p < 0.01$). Primary caregivers, caregivers for individuals with severe care needs, and caregivers with increased burden during the pandemic had a high risk of depressive symptoms.

Conclusions: Family caregivers had a high risk of depressive symptoms during the pandemic. Our findings highlight the need for a support system for family caregivers.

1. Introduction

The novel coronavirus disease (COVID-19) has had a severe global impact, with a high morbidity and mortality rate (World Health Organization 2020b; World Health Organization, Regional Office for the Western Pacific 2020; Zhu et al., 2020), and was declared a pandemic by the WHO in March 2020 (WHO, 2020a). Owing to the insufficient establishment of effective pharmacological interventions, COVID-19 management depends on public health measures to mitigate its spread and flatten the curve. This includes implementing measures that restrict

people's gatherings and limit social behavior (e.g., bans on public gatherings, stay-at-home policies, and physical distancing strategies; Hartley & Perencevich, 2020).

Although these public health strategies assist in stopping the spread of infectious diseases (Islam et al., 2020; Kucharski et al., 2020), they may have unintended secondary effects. For instance, restricting social behavior, such as going out and interacting with others, could harm people's mental health. Previous studies have shown that social-behavioral limitations during the COVID-19 pandemic could impair mental health (Iob, Frank, Steptoe, & Fancourt, 2020;

Sommerlad et al., 2021; Violant-Holz et al., 2020). Thus, in addition to the direct effects of the infection, sufficient attention should be paid to secondary health damages caused by restrictions on social behavior.

Because the severity of COVID-19 is marked in older adults (Richardson et al., 2020; WHO, Regional Office for the Western Pacific, 2020; Zhou et al., 2020), the pandemic has had a significant impact on the daily lives of older adults and their families. Particularly, restrictions on social activities and long-term care services for older adults could increase the burden on family caregivers at home, which can adversely affect family members' health. According to the conceptual model of caregiving and the stress process (Pearlin, Mullan, Semple, & Skaff, 1990), beyond the primary stressors – such as hardships and problems directly related to caregiving – role strains, social support, and intra-psychic strains can also be stressors. Additionally, because caregiving has a dyadic nature (Lyons, Zarit, Sayer, & Whitlatch, 2002), the psychosocial impact of older care recipients may increase the burden on family members. Thus, the COVID-19 pandemic and related measures, including concerns about the infection in older adults and restrictions on social behavior, can become additional stressors, which may cause more severe mental health crises for family caregivers. A previous study has shown that family caregivers are associated with several poor health conditions, including mental health during the pandemic, suggesting health disparities between caregivers and those who are not caregivers (Park, 2021). However, there are insufficient reports on the mental health conditions of family caregivers during the COVID-19 pandemic. Evidence of secondary health damages caused by the COVID-19 pandemic on family caregivers is essential in reducing the health disparities. Furthermore, identifying family caregivers suffering from more severe mental health problems is important when considering the provision of proper support for home care.

In Japan, the country with the highest global aging rate, the number of older adults who need nursing care has increased rapidly (Cabinet Office, Government of Japan, 2019). To address this issue, a public long-term care (LTC) insurance system was initiated in 2000, and LTC services were provided for residents in nursing homes and community-dwelling older adults with disabilities (Campbell & Ikegami, 2000). Overall, 6.45 million older adults (≥ 65 years old) were certified in 2018 to receive LTC services (Ministry of Health, Labour and Welfare, 2018). Of these, home care was overwhelmingly common, and LTC services were used four times more by community residents than by institutional residents (Ministry of Health, Labour and Welfare, 2018). The Japanese LTC system is focused on home care, which heavily depends on informal caregiving by families (Arai & Zarit, 2011; Sugihara, Sugisawa, & Nakatani, 2012). Traditionally, Japan has a strong familism culture, and families and relatives are often expected to provide care for frail older adults (Arai & Washio, 1999; Tamiya et al., 2011). Although the total number of COVID-19 cases in Japan is slightly lower compared to other countries (Amengual & Atsumi, 2021), the home care system for older adults may be at risk of declining during the pandemic owing to Japan's high aging rate and dependency on home care by family members. A recent study in Japan reported that the use of LTC services, especially outpatient care services, has decreased since the spread of COVID-19 (Ito et al., 2021), raising concerns about the increased burden on family caregivers. Thus, investigating the health effects of the COVID-19 pandemic on family caregivers is necessary to protect and support family caregivers' health.

The present study aimed to examine the association between family caregiving and depressive symptoms during the COVID-19 pandemic among community-dwelling older adults in Japan. Specifically, we examined data on older adults, including family caregivers, as of October 2020, between the second and third waves of the COVID-19 pandemic in Japan. This study contributes to the literature by clarifying the impact of depressive symptoms on home caregivers and identifying severely affected caregivers during the pandemic in a country with the LTC insurance system.

2. Materials and methods

2.1. Study population

In the present cross-sectional study, we made secondary use of panel data collected through a mailed questionnaire to community-dwelling older adults living in Minokamo City, a semi-urban area in Japan. Surveys were conducted in the target municipality before and after two states of emergency declarations corresponding to the waves of the COVID-19 pandemic (Japan's declaration of emergency mainly requested that individuals refrain from performing non-essential activities, maintain physical distancing, and called for self-restraint at restaurants at night; Gifu Prefectural Office, 2020; Prime Minister of Japan and His-Cabinet, 2020). The first survey was conducted as a public periodic survey of the target municipality from March 3 to 16, 2020, just before the nationwide declaration of emergency. The second survey was carried out from October 16 to 30, 2020, after the state of emergency had ended at the local prefecture level in the target survey area (Gifu Prefectural Office, 2020). The first survey randomly sampled non-institutionalized older adults aged ≥ 65 years who were not eligible to receive public LTC insurance benefits or with "support need levels" of either one or two in the public LTC system; the Japanese public LTC insurance system classifies frail older adults into seven levels: "support need levels" one and two, and "care need levels" one to five; higher numbers indicate increased care need (Tsutsui & Muramatsu, 2005). The first survey included 2000 older adults and 1350 individuals responded to the survey (response rate: 67.5%). Of these, 1106 individuals who completed the second survey (follow-up rate: 81.9%) were included in the present study. We excluded those whose age and/or sex was unanswered ($n = 3$). Additionally, to limit participants to those who were independent in their daily living, we excluded those receiving care due to difficulties in performing basic activities of daily living (BADL; $n = 58$), those with missing information on the BADL items ($n = 20$), those who reported receiving treatment for dementia ($n = 6$), and those with missing information regarding the treatment item ($n = 62$). Finally, 957 participants were included in the analysis.

This study was reviewed and approved by the ethics committees of the National Center for Geriatrics and Gerontology (No. 20TB4) and Seijoh University (No. 2020C0013). The mailed questionnaire was accompanied by an explanation of the study's purpose, and participants were informed that they could withdraw from the study at any point without facing any consequences. Informed consent was given when participants agreed to complete the questionnaire and returned the completed survey. All procedures conformed to the principles outlined in the Declaration of Helsinki.

2.2. Changes in depressive symptom status

In both the first and second surveys, depressive symptoms were assessed using the Two-Question Screen consisting of the following questions: (1) "During the past month, have you often been bothered by feeling down, depressed, or hopeless?" and (2) "During the past month, have you often been bothered by little interest or pleasure in doing things?" with possible responses of "Yes" or "No" (Sato et al., 2021; Spitzer et al., 1994). Those who answered "Yes" to either or both questions were defined as showing depressive symptoms. This two-question screening has been validated and shows comparable performance with other instruments (Tsoi, Chan, Hirai, & Wong, 2017; Whooley, Avins, Miranda, & Browner, 1997): sensitivity = 96% and specificity = 57% for major depression; sensitivity = 91.8% and specificity = 67.7% for depressive symptoms. Based on the status of depressive symptoms in the first and second surveys, participants were classified into four groups: "non-case" (without depressive symptoms in both surveys), "incidence" (without depressive symptoms in the first, but with depressive symptoms in the second survey), "remission" (with depressive symptoms in the first, but without depressive symptoms in

the second survey), and "persistence" (with depressive symptoms in both surveys).

2.3. Family caregiving

Family caregiving was assessed in the second survey using the question, "Do you care for your family currently?" Participants were dichotomized as "not caregiver" (answer: "not engaged in family caregiving") and "caregiver" (answer: "primarily engaged in family caregiving" or "not primarily engaged in, but assists with family caregiving").

In addition, the following family caregiving situations were assessed: caregiving role, the severity of care recipient's needs, and increased caregiver burden during the COVID-19 pandemic. According to the caregiving role, participants were categorized as follows: "not caregiver," "secondary caregiver," and "primary caregiver." According to the severity of care recipients' needs, participants were divided into three groups: "not caregiver," "caregiver, not severe care-level" (those at the support need levels or below the care need level 2, according to the Japanese LTC insurance system classification), "caregiver, severe care-level" (above the care need level 2), and "caregiver, care-level unknown." Furthermore, participants were asked about the increased burden of caregiving during the COVID-19 pandemic, "Do you think that the burden of caregiving for yourself has increased for you compared to before the new coronavirus infection outbreak (before March 2020)?" with response options being "not at all," "occasionally," "sometimes," "often," or "always." Based on their responses, participants were categorized as follows: "not caregiver," "caregiver, not increased caregiver burden" (answer: "not at all" or "occasionally"), and "caregiver, increased caregiver burden" (answer: "sometimes," "often," or "always").

2.4. Covariates

The covariates used data from the second survey and included the following variables: age, gender, living arrangement, educational attainment, subjective economic status, BADL, self-rated health, and present illness. Age (years) was categorized as "under 79," "80 to 84," and "85 or older." Living arrangement was categorized as "living alone," "living with spouse only," "living with spouse and child(ren)," and "other." Educational attainment (years) was categorized as "under 9," "10 to 12," and "13 or more." Subjective economic status was categorized as "severe," "normal," and "rich." BADL was assessed using the following question, "Do you need someone's care or assistance in your daily life functioning" and was dichotomized into "no difficulty" (answer: "no need for care or assistance") and "difficulty" (answer: "need some care or assistance but do not currently receive any"). Self-rated health was assessed using a single question, "What is your current health status," and was dichotomized as "poor" and "good." The present illnesses were divided into "yes" and "no" for cancer, heart disease, and stroke, respectively.

2.5. Statistical analysis

First, descriptive statistics were calculated to summarize the participants' characteristics according to family caregiving. Second, the prevalence of depressive symptoms at the time of the first and second surveys was described according to family caregiving situations. Third, family caregiving status was described according to changes in depressive symptom status. Lastly, multivariable multinomial logistic regression analysis was performed to examine the association between family caregiving status and the changes in depressive symptom status; the odds ratios (ORs) and 95% confidence intervals (CIs) for the changes in depressive symptom status were obtained. In our main analysis, family caregiving (not caregiver or caregiver) was included as an explanatory variable. In the sub-analysis, the following explanatory variables were

included: caregiving role, the severity of care recipient's needs, and increased caregiver burden during the COVID-19 pandemic. Two analytical models were created using the crude and all-covariates adjusted models. Regarding the severity of the care recipient's needs, those who answered "unknown" were excluded from the analysis because of the small sample number ($n = 5$).

To mitigate the potential biases caused by missing information, we used the multiple imputation approach under the missing at random (MAR) assumption (i.e., the missing data mechanism depends only on observed variables). We generated 20 imputed datasets using the multiple imputation by chained equations (MICE) procedure and pooled the results using the standard Rubin's rule (White, Royston, & Wood, 2011). Additionally, as a sensitivity analysis, we performed a complete case analysis.

The significance level was set at $p < 0.05$. We used R software (Version 3.6.3. for Windows; R Foundation, Vienna, Austria) for all statistical analyses. The multiple imputation approach used the MICE function (MICE package).

3. Results

The data from 957 participants were analyzed. Table 1 shows the characteristics of the participants according to their family caregiving status. The mean age was 80.8 years (standard deviation = 4.8) and 512 (53.5%) participants were females. Of the participants, 80 (8.3%) were engaged in family caregiving. Those engaged in family caregiving were likely to be older, living with others, less educated, had more severe subjective economic status, difficulty in BADL, and poor self-rated health.

Fig. 1 shows the prevalence of depressive symptoms in March (38.7%) and October (41.8%) 2020. The prevalence of depressive symptoms among those who were not caregivers was almost the same as among individuals overall (37.6% in March and 39.8% in October), whereas it later increased among caregivers (47.5% in March and 63.7% in October). For family caregivers, the prevalence of depressive symptoms increased in parallel regardless of the caregiving role and severity of care recipients' needs. Regarding the increased caregiving burden during the pandemic, those who experienced increased caregiving burden reported a considerable increase in the prevalence of depressive symptoms.

Table 2 shows the descriptive statistics of family caregiving and its situations according to changes in depressive symptom status. Regarding the changes in depressive symptoms in March and October, 408 (42.6%) participants were "non-case," 116 (12.1%) were "incidence," 107 (11.2%) were "remission," and 261 (27.3%) were "persistence."

Table 3 presents the association between family caregiving and changes in depressive symptom status. The multivariable multinomial logistic regression analysis revealed that family caregiving was significantly associated with the incidence and persistence of depressive symptoms after adjusting for covariates, including age, gender, living arrangement, subjective economic status, BADL, self-rated health, and present illness. Compared to "not caregiver," ORs (95% CIs) of "caregiver" was 3.17 (1.55 to 6.51) for the incidence of depressive symptoms ($p = 0.002$), 1.17 (0.47 to 2.91) for remission from depressive symptoms ($p = 0.743$), and 2.39 (1.30 to 4.38) for persistence of depressive symptoms ($p = 0.005$).

Additionally, regarding the caregiving role, secondary caregivers were associated with the incidence of depressive symptoms after adjusting for covariates. Primary caregivers were associated with the incidence and persistence of depressive symptoms. Regarding the severity of care recipients' needs, caregivers with not severe care-level family were marginally associated with the incidence and persistence of depressive symptoms, whereas caregivers with severe care-level family were significantly associated with the incidence and persistence of depressive symptoms. Regarding increased caregiver burden during

Table 1
Participants' characteristics.

| | | Overall | Family caregiving | | |
			Not caregiver	Caregiver	p-value*
		$n = 957$	$n = 842$	$n = 80$	
Age (years), n (%)	Under 80	450 (47.0)	402 (47.7)	36 (45.0)	0.087
	80 to 85	292 (30.5)	264 (31.4)	19 (23.8)	
	85 or older	215 (22.5)	176 (20.9)	25 (31.2)	
Gender, n (%)	Male	445 (46.5)	390 (46.3)	36 (45.0)	0.907
	Female	512 (53.5)	452 (53.7)	44 (55.0)	
Living arrangement, n (%)	Living alone	145 (15.3)	131 (15.7)	7 (8.8)	0.202
	Living with spouse only	414 (43.8)	365 (43.9)	33 (41.2)	
	Living with spouse and child (ren)	262 (27.7)	227 (27.3)	29 (36.2)	
	Other	124 (13.1)	109 (13.1)	11 (13.8)	
Educational attainment (years), n (%)	Under 9	318 (33.8)	274 (33.1)	31 (38.8)	0.564
	10 to 12	469 (49.8)	417 (50.3)	36 (45.0)	
	13 or more	154 (16.4)	138 (16.6)	13 (16.2)	
Subjective economic status, n (%)	Rich	103 (10.8)	95 (11.4)	4 (5.0)	0.130
	Normal	670 (70.5)	588 (70.4)	57 (71.2)	
	Severe	177 (18.6)	152 (18.2)	19 (23.8)	
Basic ADL, n (%)	Not difficulty	856 (89.4)	763 (90.6)	65 (81.2)	0.018
	Difficulty	101 (10.6)	79 (9.4)	15 (18.8)	
Serf-rated health, n (%)	Good	752 (79.3)	667 (80.0)	58 (72.5)	0.147
	Poor	196 (20.7)	167 (20.0)	22 (27.5)	
Cancer, n (%)	No	910 (95.1)	798 (94.8)	77 (96.2)	0.791
	Yes	47 (4.9)	44 (5.2)	3 (3.8)	
Heart disease, n (%)	No	849 (88.7)	749 (89.0)	69 (86.2)	0.460
	Yes	108 (11.3)	93 (11.0)	11 (13.8)	
Stroke, n (%)	No	932 (97.4)	818 (97.1)	79 (98.8)	0.716
	Yes	25 (2.6)	24 (2.9)	1 (1.2)	

ADL = activities of daily living.
*Chi-square test comparison of the not caregiver and caregiver groups.
Missing data: family caregiving, $n = 35$; living arrangement, $n = 12$; educational attainment, $n = 9$; subjective economic status, $n = 7$; self-rated health, $n = 9$.

the pandemic, those who did not experience an increased burden were not associated, whereas those who experienced an increased burden were significantly associated with the incidence and persistence of depressive symptoms.

These results were confirmed in a similar trend in the complete case analysis (Supplementary Table 1).

4. Discussion

The present study examined the association between family caregiving and changes in depressive symptom status among older adults during the COVID-19 pandemic. Our results indicated that family caregivers were at a higher risk of incidence and persistence of depressive symptoms. Our findings suggest a crisis in the mental health of family caregivers during the COVID-19 pandemic. Support for family caregivers is urgently needed to protect their mental health.

Family caregivers were associated with the incidence and persistence of depressive symptoms during the COVID-19 pandemic. There is much evidence of the association between family caregiving and poor mental health (Adelman, Tmanova, Delgado, Dion, & Lachs, 2014; Pinquart & Sörensen, 2003; Saito, Kondo, Shiba, Murata, & Kondo, 2018), and our results indicate that family caregivers could have an even higher risk of depressive symptoms during the pandemic. The Japanese government has not implemented "lock-down measures" as other countries did and mainly focused on controlling the spread of the disease by limiting people's social behaviors (Looi, 2020; Shimizu, Wharton, Sakamoto, and Mossialos, 2020). However, home care services for older adults were affected. After the COVID-19 outbreak, a decrease in the number of home care service users, especially outpatient care services, has been observed (Ito et al., 2021), which may have reduced the rest time of family caregivers and increased their burden. Although we have not included a comparison to normal times, family caregivers could be experiencing mental health crises during the pandemic. Furthermore, long-term epidemics related to infectious diseases would result in more severe conditions for family caregivers; further investigations are needed to examine the long-term effects on family caregivers, including caregivers' burden and quality of life, as well as effective interventions, such as outreach and peer support for home caregivers. We believe that support for family caregivers during the pandemic is an urgent issue.

Our results showed that primary caregivers, caregivers providing care to recipients with severe care needs, and caregivers experiencing increased caregiver burden had an increased risk of depressive symptoms. The tendency of impaired mental health among primary caregivers and caregivers of severe care need recipients is similar to the results of previous studies when no pandemic was present (Bédard et al., 2001; Fekete, Tough, Siegrist, & Brinkhof, 2017; He et al., 2019). As our study design did not include a comparison to normal times, the specific impact of the pandemic could not be determined; however, our results suggest that primary caregivers and caregivers of recipients with severe care needs should receive priority support even during the pandemic. Meanwhile, those who experienced increased caregiver burden during the pandemic were at a dramatically increased risk of depressive symptoms, while those who experienced no increased burden did not. These results emphasize the importance of addressing caregiver burden specifically during the pandemic to protect their mental health.

With the rapid aging of society, the informal caregiver burden has become more apparent. Particularly, in Japan, due to the strong filial piety norms, the increasing burden on family caregivers has become worrisome (Arai & Washio, 1999; Tamiya et al., 2011). Even after the establishment of the public LTC system, the burden of family members on home care cannot be ignored (Sugihara et al., 2012). In the event of an unexpected disaster, such as an infectious disease outbreak, the burden of informal caregiving could greatly exceed the capacity of family members, resulting in impairment of their mental health. Thus, our findings suggest that a social system in which the family caregiver burden does not drastically increase during natural disasters, such as epidemics, needs to be developed to reduce the negative impact on family caregivers' health. We highlight that policy makers of long-term care insurance need to politically enhance the support of family caregivers even in peacetime, and believe in the need to early detect high-risk caregivers through proactive outreach to them, provide material and psychological support, and ensure stable care services in times of disaster.

Although several important insights were gained from the present study's findings, several limitations should also be considered. First, although depressive symptoms were examined for changes between
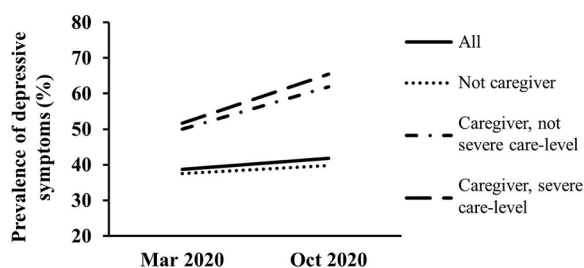
A. Depressive symptoms according to family caregiving
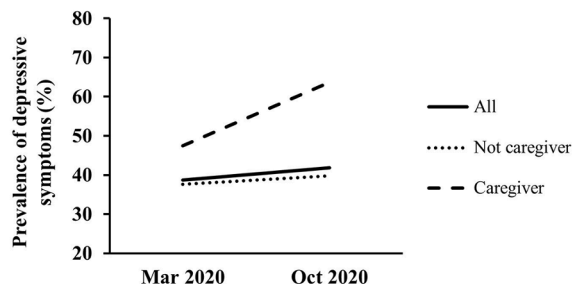
B. Depressive symptoms according to the caregiving role
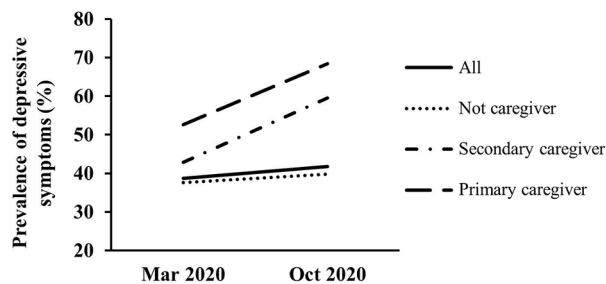
C. Depressive symptoms according to the severity of care recipient's needs

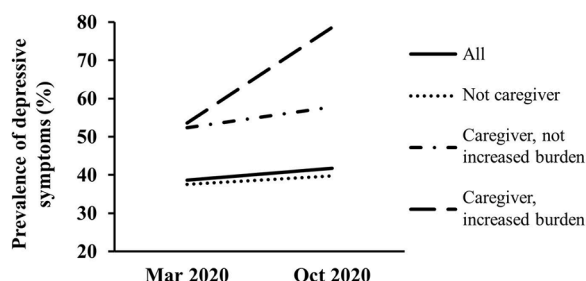**D. Depressive symptoms according to increased caregiver burden during the pandemic**

Fig. 1. Prevalence of depressive symptoms according to family caregiving situations between March and October 2020. For the prevalence, Figure A shows according to family caregiving status, Figure B shows according to caregiving role, Figure C shows the severity of care recipient's needs, and Figure D shows according to the increased caregiver burden, respectively. The prevalence of depressive symptoms between March and October 2020: All = 38.7% and 41.8%; Not caregiver = 37.6% and 39.8%; In Figure A, Caregiver = 47.5% and 63.7%. In Figure B, Secondary caregiver = 42.9% and 59.5%; Primary caregiver = 52.6% and 68.4%. In Figure C, Caregiver, not severe care-level = 50.0% and 61.9%; Caregiver, severe care-level = 51.7% and 65.5%; In Figure D, caregiver, not increased burden = 52.4% and 57.8%; Caregiver, increased burden = 53.6% and 78.6%.

Table 2
Family caregiving and its situations according to changes in depressive symptom status.

| | | Overall | Changes in depressive symptoms status* | | | | |
			Non-case	Incidence	Remission	Persistence	p-value†
		n = 957	*n* = 408	*n* = 116	*n* = 107	*n* = 261	
Family caregiving, n (%)	Not caregiver	842 (91.3)	377 (47.7)	96 (12.2)	96 (12.2)	221 (28.0)	< 0.001
	Caregiver	80 (8.7)	20 (26.7)	17 (22.7)	6 (8.0)	32 (42.7)	
Caregiving situations							
Caregiving role, n (%)	Not caregiver	842 (91.3)	377 (47.7)	96 (12.2)	96 (12.2)	221 (28.0)	0.003
	Secondary caregiver	42 (4.6)	13 (32.5)	9 (22.5)	3 (7.5)	15 (37.5)	
	Primary caregiver	38 (4.1)	7 (20.0)	8 (22.9)	3 (8.6)	17 (48.6)	
Severity of care recipient's needs, n (%)	Not caregiver	842 (91.7)	377 (47.7)	96 (12.2)	96 (12.2)	221 (28.0)	0.002‡
	Caregiver, not severe care-level§	42 (4.6)	11 (27.5)	8 (20.0)	4 (10.0)	17 (42.5)	
	Caregiver, severe care-level§	29 (3.2)	7 (25.0)	6 (21.4)	2 (7.1)	13 (46.4)	
	Unknown	5 (0.5)	0 (0.0)	2 (50.0)	0 (0.0)	2 (50.0)	
Increased burden of caregiving during the pandemic, n (%)	Not caregiver	842 (92.0)	377 (47.7)	96 (12.2)	96 (12.2)	221 (28.0)	0.006
	Caregiver, not increased burden of caregiving	45 (4.9)	13 (31.0)	7 (16.7)	4 (9.5)	18 (42.9)	
	Caregiver, increased burden of caregiving	28 (3.1)	5 (17.9)	8 (28.6)	1 (3.6)	14 (50.0)	

*Percentage of cases in each group for changes in depressive symptom status.
†Chi-square test.
‡Excluding "unknown" group.
§Divided into two by the level of care recipient's needs in the Japanese public long-term care insurance system: "not severe" (the support need levels or below the care need level 2, according to the Japanese LTC insurance system classification) and "severe" (above the care need level 2).
Missing data: changes in depressive symptom status, *n* = 65; family caregiving, *n* = 35; caregiving role, *n* = 35; severity of the care-recipient's needs, *n* = 39; increased the caregiver burden during the pandemic, *n* = 42.

Table 3
Association between family caregiving and changes of depressive symptom status, multivariable multinomial logistic regression analysis.

		Changes of depressive symptom status			
		Non-case OR (95% CI)	Incidence OR (95% CI)	Remission OR (95% CI)	Persistence OR (95% CI)
Family caregiving					
Crude model	Caregiver (ref: not caregiver)	Reference	2.95 (1.50−5.77)**	1.21 (0.49−3.00)	2.39 (1.38−4.15)**
Adjusted model	Caregiver (ref: not caregiver)	Reference	3.17 (1.55−6.51)**	1.17 (0.47−2.91)	2.39 (1.30−4.38)**
Caregiving role					
Crude model	Secondary caregiver (ref: not caregiver)	Reference	2.59 (1.11−6.02)*	0.92 (0.27−3.17)	1.84 (0.89−3.83)
	Primary caregiver (ref: not caregiver)	Reference	3.50 (1.23−9.97)*	1.60 (0.40−6.37)	3.25 (1.41−7.53)**
Adjusted model	Secondary caregiver (ref: not caregiver)	Reference	2.61 (1.03−6.63)*	0.86 (0.24−3.00)	1.70 (0.74−3.91)
	Primary caregiver (ref: not caregiver)	Reference	3.96 (1.32−11.88)*	1.59 (0.40−6.33)	3.43 (1.39−8.45)**
Severity of the care recipient's needs					
Crude model	Caregiver, not severe care-level (ref: not caregiver)	Reference	2.07 (0.84−5.11)	1.23 (0.41−3.71)	1.91 (0.96−3.81)†
	Caregiver, severe care-level (ref: not caregiver)	Reference	3.45 (1.20−9.92)*	1.14 (0.24−5.53)	2.83 (1.14−7.03)*
Adjusted model	Caregiver, not severe care-level (ref: not caregiver)	Reference	2.31 (0.89−5.99)†	1.19 (0.39−3.67)	2.06 (0.95−4.48)†
	Caregiver, severe care-level (ref: not caregiver)	Reference	3.68 (1.20−11.29)*	1.14 (0.23−5.62)	2.93 (1.08−7.90)*
Increased the caregiver burden during the pandemic					
Crude model	Caregiver, not increased burden (ref: not caregiver)	Reference	1.78 (0.74−4.26)	1.20 (0.42−3.38)	1.77 (0.91−3.44)†
	Caregiver, increased burden (ref: not caregiver)	Reference	7.19 (2.37−21.78)***	1.16 (0.16−8.72)	4.73 (1.72−13.02)**
Adjusted model	Caregiver, not increased burden (ref: not caregiver)	Reference	1.99 (0.77−5.17)	1.14 (0.40−3.28)	1.84 (0.88−3.85)
	Caregiver, increased burden (ref: not caregiver)	Reference	6.96 (2.15−22.52)**	1.14 (0.15−8.74)	4.32 (1.45−12.93)**

CI = confidence interval; OR = odds ratio.
*, p < 0.05; **, p < 0.01; ***, p < 0.001; †, p < 0.1.
Adjusted model included age, gender, living arrangement, educational attainment, subjective economic status, basic activities of daily living (ADL) difficulty, self-rated health, and present illness (cancer, heart disease, and stroke).
Missing data for variables were imputed by multiple imputation approach.

March 2020 (first survey) and October (second survey) in 2020, family caregiving was assessed only in the second survey. Therefore, the temporal relationship between family caregiving and depressive symptoms could not be examined and its cross-sectional nature means that there may be potential for reverse causality. Further studies with longitudinal analytical design are required. Second, we did not have information about the status of the participants' depressive symptoms during non-pandemic circumstances and could not consider it. Our first survey (March 2020) took place when the COVID-19 pandemic had already begun in Japan (Karako, Song, Chen, Tang, & Kokudo, 2021), which may have already impaired people's mental health. However, because Japan had far fewer cases than other countries during the first wave (WHO, 2020c) and our first survey was conducted just before the state of emergency declaration that triggered strong social behavioral restrictions (Kuniya, 2020), our first survey data may be relatively close to non-pandemic conditions. Third, many of the variables used in this study were based on self-administered questionnaires, which may have caused information bias in key variables, such as depressive symptoms, caregiving, and BADL. These could have affected the internal validity of our results. However, despite these limitations, we believe there is some meaning in reporting the effects on caregivers during the pandemic. Fourth, we did not have much information about caregivers and care recipients. Caregiving is dyadic, which means that caregivers and care recipients could influence each other (Lyons et al., 2002). For instance, we could not examine the effects of differences in family relationships, including caregiving for a spouse or others. In addition, most of the information on care recipients could not be evaluated (e.g., their illness, including dementia, and their use of care services); these factors could have caused residual confounding. Further studies using detailed dyadic data about caregivers and care recipients are needed. Fifth, we only evaluated the presence of family caregiving and could not objectively evaluate its burden. This may have caused misclassifications in the evaluation of family caregiving. Sixth, this study was based on the secondary use of public survey data from the targeted municipality; thus, the sample size estimation was not performed and the small number of samples for caregivers may have caused instability in the estimates. Finally, our study participants were slightly older than the typical

community-dwelling older adults and our survey was limited to a semi-urban area in Japan. These issues may reduce the generalizability of our results.

5. Conclusions

In conclusion, the present study indicated that family caregiving was associated with the incidence of depressive symptoms and caregivers remained depressed during the COVID-19 pandemic. Particularly, primary caregivers, caregivers providing care to individuals with severe care needs, and caregivers who experienced increased caregiver burden during the pandemic had an increased risk of depressive symptoms. Whereas in our study there could be biases in measuring variables for depressive symptoms and caregiving, our findings suggest that family caregivers could be suffering from depressive symptoms during the pandemic, and developing a support system for them is urgently needed.

Declaration of Competing Interest

The authors declare no conflict of interest.

Acknowledgments

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.archger.2021.104468.

References

Adelman, R. D., Tmanova, L. L., Delgado, D., Dion, S., & Lachs, M. S. (2014). Caregiver burden: a clinical review. *JAMA, 311*(10), 1052–1060. https://doi.org/10.1001/jama.2014.304

Amengual, O., & Atsumi, T. (2021). COVID-19 pandemic in Japan. *Rheumatology International, 41*(1), 1–5. https://doi.org/10.1007/s00296-020-04744-9

Arai, Y., & Washio, M. (1999). Burden felt by family caring for the elderly members needing care in southern Japan. *Aging & Mental Health, 3*(2), 158–164. https://doi.org/10.1080/13607869956325

Arai, Y., & Zarit, S. H. (2011). Exploring strategies to alleviate caregiver burden: Effects of the national long-term care insurance scheme in Japan. *Psychogeriatrics, 11*(3), 183–189. https://doi.org/10.1111/j.1479-8301.2011.00367.x

Bédard, M., Raney, D., Molloy, D. W., Lever, J., Pedlar, D., & Dubois, S. (2001). The experience of primary and secondary caregivers caring for the same adult with Alzheimer's disease. *Journal of Mental Health and Aging, 7*(2), 287–296.

Cabinet Office, Government of Japan. (2019). White Paper on Aging Society [White paper]. https://www8.cao.go.jp/kourei/whitepaper/w-2019/html/zenbun/s1_2_2.html.

Campbell, J. C., & Ikegami, N. (2000). Long-term care insurance comes to Japan. *Health Affairs (Millwood), 19*(3), 26–39. https://doi.org /10.1377/hlthaff.19.3.26.

Fekete, C., Tough, H., Siegrist, J., & Brinkhof, M. W. (2017). Health impact of objective burden, subjective burden and positive aspects of caregiving: An observational study among caregivers in Switzerland. *BMJ Open, 7*(12), Article e017369. https://doi.org/10.1136/bmjopen-2017-017369

Gifu Prefectural Office. (2020). Information on a new type of coronavirus infection in Gifu Prefecture. "Emergency Measures for "second wave emergency" (Governor's Message). *Accessed April, 12*, 2021. https://www.pref.gifu.lg.jp/site/covid19/62123.html.

Hartley, D. M., & Perencevich, E. N. (2020). Public health interventions for COVID-19: Emerging evidence and implications for an evolving public health crisis. *JAMA, 323*(19), 1908–1909. https://doi.org/10.1001/jama.2020.5910

He, M., Ma, J., Ren, Z., Zhou, G., Gong, P., Liu, M., & Zhang, X. (2019). Association between activities of daily living disability and depression symptoms of middle-aged and older Chinese adults and their spouses: A community-based study. *Journal of Affective Disorders, 242*, 135–142. https://doi.org/10.1016/j.jad.2018.08.060

Iob, E., Frank, P., Steptoe, A., & Fancourt, D. (2020). Levels of severity of depressive symptoms among at-risk groups in the uk during the COVID-19 pandemic. *JAMA Network Open, 3*(10), Article e2026064. https://doi.org/10.1001/jamanetworkopen.2020.26064

Islam, N., Sharp, S. J., Chowell, G., Shabnam, S., Kawachi, I., Lacey, B., & White, M. (2020). Physical distancing interventions and incidence of coronavirus disease 2019: Natural experiment in 149 countries. *BMJ, 370*, 2743. https://doi.org/10.1136/bmj.m2743

Ito, T., Hirata-Mogi, S., Watanabe, T., Sugiyama, T., Jin, X., Kobayashi, S., & Tamiya, N. (2021). Change of use in community services among disabled older adults during COVID-19 in Japan. *International Journal of Environmental Research and Public Health, 18*(3), 1148. https://doi.org/10.3390/ijerph18031148

Karako, K., Song, P., Chen, Y., Tang, W., & Kokudo, N. (2021). Overview of the characteristics of and responses to the three waves of COVID-19 in Japan during 2020-2021. *BioScience Trends, 15*(1), 1–8. https://doi.org/10.5582/bst.2021.01019

Kucharski, A. J., Klepac, P., Conlan, A. J. K., Kissler, S. M., Tang, M. L., Fry, H., & Edmunds, W. J. (2020). Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: A mathematical modelling study. *The Lancet Infectious Diseases, 20*(10), 1151–1160. https://doi.org/10.1101/2020.04.23.20077024

Kuniya, T. (2020). Evaluation of the effect of the state of emergency for the first wave of COVID-19 in Japan. *Infectious Disease Modelling, 5*, 580–587. https://doi.org/10.1016/j.idm.2020.08.004

Looi, M. K. (2020). Covid-19: Japan ends state of emergency but warns of "new normal. *BMJ, 369*, 2100. https://doi.org/10.1136/bmj.m2100

Lyons, K. S., Zarit, S. H., Sayer, A. G., & Whitlatch, C. J. (2002). Caregiving as a dyadic process: Perspectives from caregiver and receiver. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 57*(3), 195–204. https://doi.org/10.1093/geronb/57.3.p195

Ministry of Health, Labour and Welfare. (2018). Report for provision of long-term care insurance (Kaigo Hoken Jigyo Jokyo Houkoku). Retrieved from https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/18/index.html. Accessed April 12, 2021.

Park, S. S. (2021). Caregivers' mental health and somatic symptoms during COVID-19. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 76*(4), e235–e240. https://doi.org/10.1093/geronb/gbaa121

Pearlin, L. I., Mullan, J. T., Semple, S. J., & Skaff, M. M. (1990). Caregiving and the stress process: An overview of concepts and their measures. *Gerontologist, 30*(5), 583–594. https://doi.org/10.1093/geront/30.5.583

Pinquart, M., & Sörensen, S. (2003). Differences between caregivers and noncaregivers in psychological health and physical health: A meta-analysis. *Psychology and Aging, 18*(2), 250–267. https://doi.org/10.1037/0882-7974.18.2.250

Prime Minister of Japan and His Cabinet. (2020). [COVID-19] Press conference by the Prime Minister regarding the declaration of a state of emergency [Press release]. Retrieved from https://japan.kantei.go.jp/98_abe/statement/202004/_00001.html. Accessed April 12, 2021.

Richardson, S., Hirsch, J. S., Narasimhan, M., Crawford, J. M., McGinn, T., Davidson, K. W., & Zanos, T. P. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City Area. *Jama, 323*(20), 2052–2059. https://doi.org/10.1001/jama.2020.6775

Saito, T., Kondo, N., Shiba, K., Murata, C., & Kondo, K. (2018). Income-based inequalities in caregiving time and depressive symptoms among older family caregivers under the Japanese long-term care insurance system: A cross-sectional analysis. *PLoS One, 13*(3), Article e0194919. https://doi.org/10.1371/journal.pone.0194919

Sato, K., Sakata, R., Murayama, C., Yamaguchi, M., Matsuoka, Y., & Kondo, N. (2021). Changes in work and life patterns associated with depressive symptoms during the COVID-19 pandemic: an observational study of health app (CALO mama) users. *Occupational and Environmental Medicine, 22*, oemed–2020-106945. https://doi.org/10.1136/oemed-2020-106945

Shimizu, K., Wharton, G., Sakamoto, H., & Mossialos, E. (2020). Resurgence of covid-19 in Japan. *BMJ, 370*, m3221. https://doi.org/10.1136/bmj.m3221

Sommerlad, A., Marston, L., Huntley, J., Livingston, G., Lewis, G., Steptoe, A., & Fancourt, D. (2021). Social relationships and depression during the COVID-19 lockdown: Longitudinal analysis of the COVID-19 Social Study. *Psychological Medicine*, 1–10. https://doi.org/10.1101/2020.12.01.20241950

3rd Spitzer, R. L., Williams, J. B., Kroenke, K., Linzer, M., deGruy, F. V., Hahn, S. R., & Johnson, J. G. (1994). Utility of a new procedure for diagnosing mental disorders in primary care. The PRIME-MD 1000 study. *JAMA, 272*(22), 1749–1756. https://doi.org/10.1001/jama.272.22.1749.

Sugihara, Y., Sugisawa, H., & Nakatani, Y. (2012). Use of in-home services before and after the introduction, revision of nursing-care insurance system and changes in feeling of burden of care—Understanding of secular change based on repeated crossing survey. *Journal of Health and Welfare Statistics, 59*(15), 1–9. https://dx.doi.org/10.3390%2Fhealthcare8020087.

Tamiya, N., Noguchi, H., Nishi, A., Reich, M. R., Ikegami, N., Hashimoto, H., & Campbell, J. C. (2011). Population ageing and wellbeing: Lessons from Japan's long-term care insurance policy. *The Lancet, 378*(9797), 1183–1192. https://doi.org/10.1016/s0140-6736(11)61176-8

Tsoi, K. K., Chan, J. Y., Hirai, H. W., & Wong, S. Y. (2017). Comparison of diagnostic performance of two-question screen and 15 depression screening instruments for older adults: Systematic review and meta-analysis. *British Journal of Psychiatry, 210*(4), 255–260. https://doi.org/10.1192/bjp.bp.116.186932

Tsutsui, T., & Muramatsu, N. (2005). Care-needs certification in the long-term care insurance system of Japan. *Journal of the American Geriatrics Society, 53*(3), 522–527. https://doi.org/10.1111/j.1532-5415.2005.53175.x

Violant-Holz, V., Gallego-Jiménez, M. G., González-González, C. S., Muñoz-Violant, S., Rodríguez, M. J., Sansano-Nadal, O., & Guerra-Balic, M. (2020). Psychological health and physical activity levels during the COVID-19 pandemic: A systematic review. *International Journal of Environmental Research and Public Health, 17*(24). https://doi.org/10.3390/ijerph17249419

White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine, 30*(4), 377–399. https://doi.org/10.1002/sim.4067

Whooley, M. A., Avins, A. L., Miranda, J., & Browner, W. S. (1997). Case-finding instruments for depression. Two questions are as good as many. *Journal of General Internal Medicine, 12*(7), 439–445. https://doi.org/10.1046/j.1525-1497.1997.00076.x

World Health Organization. (2020 a). Archived: WHO timeline - COVID-19. Retrieved from https://www.who.int/news/item/27-04-2020-who-timeline—covid-19. Accessed April 12, 2021.

World Health Organization. (2020 b). Coronavirus disease 2019 (COVID-19). Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019. Accessed April 12, 2021.

World Health Organization. (2020 c). WHO Coronavirus Disease (COVID-19) Dashboard. Retrieved from https://covid19.who.int/. Accessed May 10, 2021.

World Health Organization, Regional Office for the Western Pacific. (2020). *Guidance on COVID-19 for the care of older people and people living in long-term care facilities.* other nonacute care facilities and home care Manila. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/331913/COVID-19-emergency-guidance-ageing-eng.pdf?sequence=1&isAllowed=y Accessed April 12, 2021.

Zhou, F., Yu, T., Du, R., Fan, G., Liu, Y., Liu, Z., & Cao, B. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. *The Lancet, 395*(10229), 1054–1062. https://doi.org/10.1016/s0140-6736(20)30566-3

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., & Tan, W. (2020). A Novel coronavirus from patients with pneumonia in China, 2019. *New England Journal of Medicine, 382*(8), 727–733. https://doi.org/10.1056/NEJMoa2001017