

## ORIGINAL ARTICLE

# Depressed mood and frailty among older people in Tokyo during the COVID-19 pandemic

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## INTRODUCTION

The coronavirus disease 19 (COVID-19) pandemic has spread around the world. In Japan, the number of patients rapidly increased in March, followed by an emergency state declaration by the government on April 7, 2020. Because social distancing was recommended, nonessential businesses, schools, sports and recreational facilities, and places of worship were closed. Residents were asked to stay in their homes. Although the government did not take mandatory action to ensure that people remained at home, the

## Abstract

**Background:** The study aim was to identify depressed mood and frailty and its related factors in older people during the coronavirus disease 19 pandemic.

**Methods:** Since 2010, we have conducted questionnaire surveys on all older residents, who are not certified in the long-term care insurance, living in one district of Tokyo municipality. These residents are divided into two groups by birth month, that is those born between April and September and those born between October and March, and each group completes the survey every 2 years (in April and May). Study participants were older residents who were born between April and September and who completed the survey in spring 2018 and in spring 2020, the pandemic period. Depressed mood and frailty were assessed using the Kihon Checklist, which is widely used by local governments in Japan. We had no control group in this study.

**Results:** A total of 1736 residents responded to both surveys. From 2018 to 2020, the depressed mood rate increased from 29% to 38%, and frailty increased from 10% to 16%. The incidence of depressed mood and frailty was 25% and 11%, respectively. Incidence of depressed mood was related to subjective memory impairment and difficulty in device usage, and incidence of frailty was related to being older, subjective memory impairment, lack of emotional social support, poor subjective health, and social participation difficulties.

**Conclusions:** Older people with subjective memory impairment may be a high-risk group during the coronavirus pandemic. Telephone outreach for frail older people could be an effective solution. We recommend extending the scope of the ‘reasonable accommodation’ concept beyond disability and including older people to build an age-friendly and crisis-resistant community.

number of people outside substantially decreased during the emergency state; according to the Japanese Cabinet Office, the number of people circulating in the five large stations in the Tokyo metropolitan area, as measured by mobile phone geographical data (approved by owners for public use), decreased from 68.9% to 87.3% compared with average data in January and February.<sup>1</sup>

The risk of severe illness from COVID-19 increases with age, and older adults are at highest risk.<sup>2</sup> This is because: (i) frailty in older adults increases the risk of

various infections and reduces all aspects of the immune response; and (ii) older people have multiple comorbidities and more hospitalisations, which increases the chance of infection during a pandemic.<sup>3</sup> Thus, older adults are particularly cautious about the risk of getting infected and avoided contacting with others in person.

However, social isolation in older people is a serious public health concern, because of the greater risk of physical and mental health problems in older people.<sup>4</sup> According to Santini *et al.*,<sup>5</sup> social disconnection puts older adults at greater risk of depression. A comparison of the National Health Interview Survey 2018 and 2020 shows that psychological distress and loneliness have increased during the COVID-19 pandemic.<sup>6</sup> In addition, social distancing is a risk factor for progressive frailty, as it reduces physical activity.<sup>7</sup>

In Japan, several measures have been used to assess depressed mood among older people. The most widely used measure is the Kihon Checklist (KCL), which is described in the methods section. One survey that used the KCL found that 25% of older people had depressed mood.<sup>8</sup> However, to the best of our knowledge, no previous studies have used the KCL to assess the onset of depressed mood. Another widely used scale is the 15-item Geriatric Depression Scale<sup>9</sup>; scores of five or greater on this scale indicate depressive symptoms. A study of older people in Japan found that the prevalence of depressive symptoms was 25%.<sup>10</sup> A large-scale multicentre longitudinal study showed that the incidence of depressive symptoms over 3 years was 16.5% for men and 15.7% for women.<sup>11</sup>

In Japan, frailty is often assessed using the KCL or the Japanese version of the Cardiovascular Health Study criteria (CHS).<sup>12</sup> A meta-analysis of studies that used the CHS found a pooled prevalence of frailty of 7.4% (95% confidence interval (CI) 6.1–9.0).<sup>13</sup> However, to the best of our knowledge, there are no CHS data on the incidence of frailty. One study that used the KCL found a frailty prevalence of 8% and a 5-year onset of frailty of 8%.<sup>14</sup>

The aim of this study was to identify psychological and physical changes in older people by comparing 2020 data (collected during the COVID-19 pandemic) with 2018 data from the same population. An additional aim was to identify factors related to psychological and physical changes.

## METHODS

### Introduction

Since 2010, we have conducted an epidemiological survey of older people living in one district of Tokyo.<sup>15–17</sup> Questionnaires are usually mailed in April; this year, Japan was in an emergency state at this time. Although there was substantial societal disruption, the local government decided to mail the questionnaires as planned to obtain a rapid assessment of the situation and to prioritise focused support.

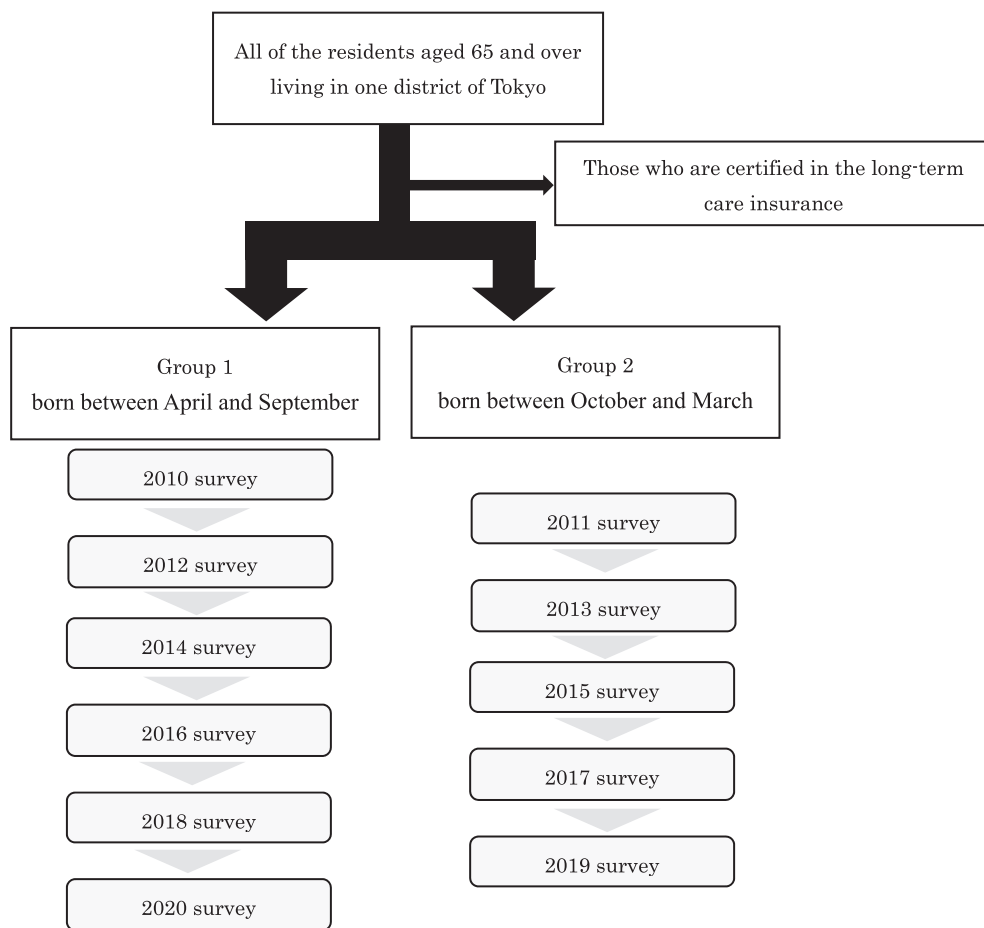
### Participants

In close collaboration with local government, we have conducted epidemiological surveys of all older people (i.e., individuals aged 65 years or over, which is the official definition of ‘older people’ in Japan) not certified in the long-term care insurance (LTCI) scheme and living in one district of Tokyo. Respondents are divided into two groups by birth month: those born between April and September comprise group 1 and those born between October and March comprise group 2. Groups 1 and 2 complete the surveys in odd years and even years, respectively; the group 2 survey started in 2010 and has been conducted every 2 years. The annual alternation of groups 1 and 2 equalises the yearly workload for local government. The flow of the project is shown in Figure 1. The participants of this study were older people from group 1 who responded to both the 2018 survey and the 2020 survey. The study flow is shown in Figure 2.

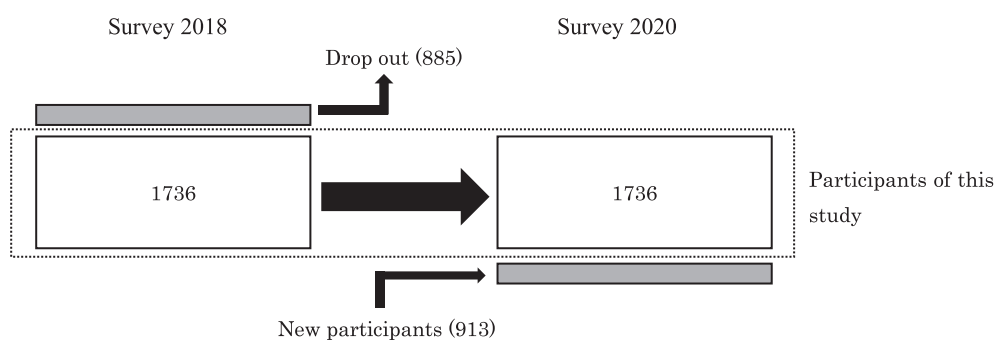
Japan’s LTCI is a mandatory program that provides institutional, home, and community-based services for older persons. To use long-term care services, applicants must receive long-term care need certification, which is determined by a committee of specialists.<sup>18</sup>

### Setting

This study was conducted in one district which is located in the centre of the Tokyo metropolitan area. The total population is approximately 67 000, including 11 000 people aged 65 years or over. According to publicly available data, the LTCI certification rate of this district is 20.2%.<sup>19</sup> Every year, the local government mails a questionnaire to respondents in April. Respondents are asked to mail the questionnaire back by May 29.



**Figure 1** Flow chart of the project.



**Figure 2** Flow chart of the study.

**Measures**

As this survey was a joint project with local government, it included the KCL. The KCL was developed by the Japanese Ministry of Health, Labour and Welfare to identify older people at risk of requiring care/support, and is widely used by local governments to assess health and care needs.<sup>20</sup> The KCL comprises 20 items about the overall health status of older

people and five items that assess depressed mood.<sup>21</sup> Response options for each item are ‘yes’ and ‘no’. Depressed mood and frailty scores were derived from KCL responses.

**Main outcome**

*Depressed mood.* The five KCL items that assess depressed mood measure lack of fulfilment, lack of

joy, difficulty in doing what one could easily do before, helplessness, and tiredness without a reason. Participants who answered yes to two or more items were considered to have depressed mood.<sup>8</sup>

**Frailty.** The 20 KCL items that assess overall health status were used to measure frailty. Satake *et al.*<sup>22</sup> noted that the total KCL score is strongly correlated with frailty, as defined in the CHS criteria. Cutoffs of 7/8 for the 20 KCL health items were used as the threshold to identify frailty. The KCL was shown to be adequate for cross-cultural studies and to be suitable for addressing frailty demands among elderly people in multiple cohorts.<sup>23</sup>

### Covariates

**Basic information.** We collected data on age, gender, living status (living alone or not), marital status (married or not), working status (working or not), education (completed mandatory education and above), and being a new resident or not (the cutoff was set at 10 years of residence in current location).

**Memory-related variables (subjective memory impairment).** We assessed participants' forgetfulness about the location of things, and forgetfulness about things that happened a few minutes earlier. Questions were adapted from the Dementia Assessment Sheet for Community-based Integrated Care System-21 items (DASC-21),<sup>24</sup> which is widely used with the Japanese national dementia strategy.

**Physical health-related variables.** Body height and body weight were assessed to calculate body mass index. Subjective health was assessed using a four-item Likert scale and responses were categorised overall as indicating 'healthy' or 'not healthy.' The presence of hypertension, stroke, heart disease, diabetes mellitus, hyperlipidaemia, and cancer was recorded. Participants were also asked about their concern regarding their oral health.

**Daily life competence.** Daily life competence was assessed using items adapted from the Japan Science and Technology Agency Index of Competence (JST-IC).<sup>25, 26</sup> The JST-IC consists of 16 items that assess four domains: device usage (four items), information gathering (four items), life management (four items), and social participation (four items). We used the items 'to operate a video recorder,' 'to watch educational programs,' 'to take care of your family members or acquaintances,' and 'to assume roles such as the leader in a residents' association' from

each domain. Potential item responses were 'possible' or 'impossible.'

**Psychological variables.** Emotional social support was assessed by a question about whether the participant had someone to consult when they were ill. Instrumental social support was assessed by a question about whether the participant had someone who would take care of them when they were ill. Both items were adapted from the report by Muraoka *et al.*<sup>27</sup>

### Data analysis

Of participants considered not to have depressed mood in the 2018 survey, those judged to have depressed mood in the 2020 survey were regarded as the 'new depressed mood' group. Similarly, of participants considered not to show frailty in the 2018 survey, those judged to show frailty in the 2020 survey were regarded as the 'new frailty' group.

Characteristics of the new depressed mood group and new frailty group were compared with controls using the Chi-square test for nominal variables and the *t*-test for continuous variables.

Multivariate logistic regression analyses were subsequently performed. The dependent variables were new depressed mood and new frailty, and factors showing significant associations in the previous bivariate analysis were included. Age was converted to a two-value item: young-old (65–74 years) and old-old ( $\geq 75$  years).  $P < 0.05$  was regarded as statistically significant. For the memory-related items (i.e., forgetfulness about the location of things and forgetfulness about things that happened a few minutes earlier), only one item was included in the multivariate analysis to avoid multicollinearity. In both multivariate logistic regression analyses, the variance inflation factor was less than 2.0 for all items, indicating no multicollinearity. Analyses were performed using SPSS version 25 (IBM Corp, Armonk, NY, USA).

### Ethical considerations

The study protocol was approved by the ethics committee of the Tokyo Metropolitan Institute of Gerontology. Written informed consent was obtained from all participants.

**RESULTS**

The number of mailed questionnaires for residents aged 65 years or above and born between April and September was 4914 in 2018, and 2621 questionnaires were retrieved (response rate 53.3%). Similarly, the number of mailed questionnaires was 4973 in 2020, and 2649 questionnaires were retrieved (response rate 53.3%). A total of 1736 residents responded to both surveys (i.e., the rate of analysed questionnaires per mailed questionnaires was 35.3% and 34.6%, respectively).

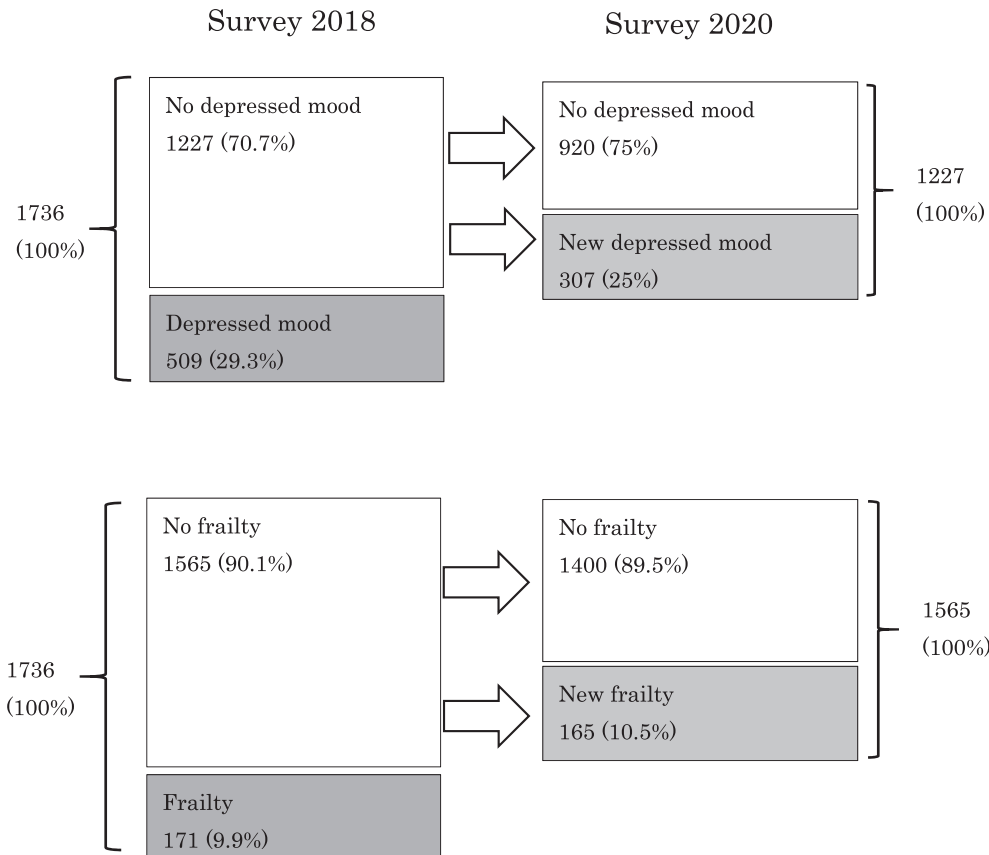
In 2018, 29% of participants had depressed mood and 10% showed frailty. In 2020, 38% of participants had depressed mood and 16% showed frailty. A simple comparison showed that the rates of depressed mood and frailty increased in 2020 (Table 1).

**Table 1** Ratio of participants who had depressed mood and frailty

	2018	2020
Depressed mood	29%	38%
Frailty	10%	16%

Of the 1736 participants, 509 participants had depressed mood and 1227 did not in 2018. Of these 1227 participants, 307 had depressed mood in 2020. That is, the depressed mood progression rate was 25%. Of the 1736 participants, 171 participants had frailty and 1565 did not in 2018. Of these 1565 participants, 165 had frailty in 2020 (Fig. 3).

The comparative characteristics of participants who developed depressed mood in 2020 and those who did not are shown in Table 2. Being older, not married, low education level, residing in current location for longer than 10 years, being forgetful about the location of things, being forgetful about things that happened a few minutes earlier, difficulty operating a video recorder, difficulty watching educational programs, difficulty taking care of family members or acquaintances, and lack of emotional social support were related to new depressed mood. The multivariate logistic regression analysis showed that subjective memory impairment (forgetfulness about the location of things) (odds ratio (OR) = 1.47, 95% CI: 1.11–1.94) and difficulty using devices (operating a



**Figure 3** Incidence of depressed mood and frailty.

**Table 2** Comparative characteristics of new depressed mood group

Basic information	New depressed mood (N = 307)	No depressed mood (N = 920)
Age	77.3 ± 6.4	76.1 ± 6.0**
Gender		
Male	124 (23%)	409 (77%)
Female	183 (26%)	511 (74%)
Living status		
Living alone	81 (28%)	209 (72%)
Not living alone	226 (24%)	711 (76%)
Marital status		
Married	186 (23%)	621 (77%)
Not married	116 (29%)	285 (71%)
Working status		
Having job	163 (25%)	495 (75%)
Not having job	130 (25%)	395 (75%)
Education		
Mandatory level	38 (35%)	70 (65%)*
Others	269 (24%)	850 (76%)
New residents		
10 years and less	49 (20%)	201 (80%)*
11 years and over	258 (26%)	719 (74%)
Memory-related variables (subjective memory impairment)		
Forgetfulness about the place of things		
Present	192 (28%)	492 (72%)**
Absent	115 (21%)	428 (79%)
Forgetfulness about the things a few minutes before		
Present	105 (30%)	249 (70%)*
Absent	202 (23%)	671 (77%)
Physical health-related variables		
BMI	22.5 ± 3.1	22.5 ± 3.1
Subjective health		
Not healthy	13 (29%)	32 (71%)
Healthy	259 (25%)	794 (75%)
Hypertension		
Present	127 (25%)	374 (75%)
Absent	168 (25%)	490 (75%)
Stroke		
Present	10 (19%)	43 (81%)
Absent	285 (26%)	821 (74%)
Heart disease		
Present	37 (27%)	101 (73%)
Absent	258 (25%)	763 (75%)
Diabetes		
Present	37 (27%)	102 (73%)
Absent	258 (25%)	762 (75%)
Hyperlipidaemia		
Present	35 (22%)	122 (78%)
Absent	260 (26%)	742 (74%)
Cancer		
Present	48 (28%)	124 (72%)
Absent	247 (25%)	740 (75%)
Oral health care		
Absent	23 (29%)	57 (71%)
Present	280 (25%)	852 (75%)

**Table 2** Continued

Japan Science and Technology Agency Index of Competence		
To operate a video recorder		
No	83 (33%)	167 (67%)**
Yes	217 (23%)	726 77 (%)
To watch educational programs		
No	68 (31%)	155 (70%)*
Yes	236 (24%)	756 (76%)
To take care of your family members or acquaintances		
No	86 (35%)	158 (65%)**
Yes	211 (22%)	732 (78%)
To assume roles such as the leader in a residents' association		
No	156 (27%)	429 (73%)
Yes	145 (23%)	475 (77%)
Psychological variables		
Emotional social support		
Absent	18 (41%)	26 (59%)*
Present	288 (24%)	890 (76%)
Instrumental social support		
Absent	58 (30%)	138 (70%)
Present	244 (24%)	769 (76%)

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ . BMI, body mass index.

**Table 3** Factors associated with incidence of depressed mood in multivariate analysis

	OR	95% CI
Subjective memory impairment (forgetfulness about the place of things)	1.47	1.11–1.94**
Difficulty in device usage (to operate a video recorder)	1.45	1.04–2.03*

\* $P < 0.05$ ; \*\* $P < 0.01$ . OR, odds ratio; CI, confidence interval. Factors included in this model analysis: (i) basic variables such as age, education, new residential status; (ii) forgetfulness about the location of things (to assess subjective memory impairment); (iii) items to assess instrumental activities of daily living such as difficulty operating a video recorder, difficulty watching educational programs, and difficulty taking care of family members or acquaintances; and (iv) emotional social support (to assess psychological variables). Age was converted to a dichotomous variable: young-old (65–74 years) and old-old ( $\geq 75$  years).

video recorder) (OR = 1.45, 95% CI: 1.04–2.03) were significantly associated with new depressed mood (Table 3).

**Table 4** Comparative characteristics of new frailty group

Basic information	New frailty (N = 165)	No frailty (N = 1400)
Age	79.8 ± 6.8	76.3 ± 6.0***
Gender		
Male	60 (10%)	544 (90%)
Female	83 (10%)	740 (90%)
Living status		
Living alone	54 (14%)	339 (86%)*
Not living alone	111 (10%)	1061 (91%)
Marital status		
Married	83 (8%)	924 (92%)*
Not married	81 (15%)	457 (85%)
Working status		
Having job	72 (9%)	742 (91%)*
Not having job	86 (12%)	610 (88%)
Education		
Mandatory level	31 (22%)	108 (78%)*
Others	134 (9%)	1292 (91%)
New residents		
10 years and less	28 (9%)	277 (91%)
11 years and over	137 (11%)	1123 (89%)
Memory-related variables (subjective memory impairment)		
Forgetfulness about the place of things		
Present	110 (12%)	813 (88%)*
Absent	55 (9%)	587 (91%)
Forgetfulness about the things a few minutes before		
Present	86 (17%)	414 (83%)*
Absent	79 (7%)	986 (93%)
Physical health-related variables		
BMI	22.3 ± 3.1	22.6 ± 3.3
Subjective health		
Not healthy	15 (19%)	63 (81%)*
Healthy	128 (10%)	1196 (90%)
Hypertension		
Present	77 (12%)	592 (89%)
Absent	82 (10%)	746 (90%)
Stroke		
Present	10 (15%)	59 (86%)
Absent	149 (10%)	1279 (90%)
Heart disease		
Present	25 (13%)	165 (87%)
Absent	134 (10%)	1173 (90%)
Diabetes		
Present	23 (12%)	170 (88%)
Absent	136 (10%)	1168 (90%)
Hyperlipidaemia		
Present	22 (10%)	195 (90%)
Absent	137 (11%)	1143 (89%)
Cancer		
Present	29 (13%)	198 (87%)
Absent	130 (10%)	1140 (90%)
Oral health care		
Absent	21 (17%)	101 (83%)*
Present	143 (10%)	1291 (90%)
Japan Science and Technology Agency		

**Table 4** Continued

Index of Competence		
To operate a video recorder		
No	62 (17%)	294 (83%)*
Yes	96 (8%)	1041 (92%)
To watch educational programs		
No	49 (15%)	269 (85%)*
Yes	114 (10%)	1086 (91%)
To take care of your family members or acquaintances		
No	83 (17%)	419 (84%)*
Yes	77 (8%)	928 (92%)
To assume roles such as the leader in a residents' association		
No	111 (14%)	677 (86%)*
Yes	51 (7%)	670 (93%)
Psychological variables		
Emotional social support		
Absent	20 (24%)	64 (76%)*
Present	144 (10%)	1302 (90%)
Instrumental social support		
Absent	49 (16%)	256 (84%)*
Present	110 (9%)	1099 (91%)

\**P* < 0.05; \*\**P* < 0.01; \*\*\**P* < 0.001. BMI, body mass index.

The comparative characteristics of older people who had developed frailty in 2020 and those who had not are shown in Table 4. Being older, not married, living alone, low education level, not having a job, being forgetful about the location of things, being forgetful about things that happened a few minutes earlier, poor subjective health, lack of concern regarding their oral health, difficulty operating a video recorder, difficulty watching educational programs, difficulty taking care of family members or acquaintances, difficulty in assuming roles such as the leader in a residents' association, lack of emotional social support, and lack of instrumental social support were related to new frailty. The multivariate logistic regression analysis showed that being young-old (OR = 1.87, 95% CI: 1.18–2.97), subjective memory impairment (forgetfulness about things that happened a few minutes earlier) (OR = 2.18, 95% CI: 1.47–3.22), lack of emotional social support (OR = 2.64, 95% CI: 1.34–5.13), poor subjective health (OR = 2.27, 95% CI: 1.16–4.44), and difficulty in social participation (difficulty assuming roles such as the leader in a residents'

**Table 5** Factors associated with incidence of frailty in multivariate analysis

	OR	95% CI
Older	1.87	1.18–2.97**
Subjective memory impairment (forgetfulness about the things a few minutes before)	2.18	1.47–3.22***
Lack of emotional social support	2.64	1.34–5.13**
Poor subjective health	2.27	1.16–4.44*
Difficulty in social participation (not to assume roles such as the leader in a residents' association)	1.92	1.25–2.95**

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ . OR, odds ratio; CI, confidence interval. Factors included in this model analysis: (i) basic variables such as age, living status, marital status, working status, and education; (ii) forgetfulness about things that happened a few minutes earlier (to assess subjective memory impairment); (iii) physical health-related items such as subjective health and oral health care; (iv) items about instrumental activities of daily living such as difficulty operating a video recorder, difficulty watching educational programs, difficulty taking care of family members or acquaintances, and difficulty assuming roles (e.g., the leader) in a residents' association; and (v) psychological variables such as emotional social support and instrumental social support. Age was converted to a dichotomous variable: young-old (65–74 years) and old-old ( $\geq 75$  years).

association) (OR = 1.92, 95% CI: 1.25–2.95) were significantly associated with new frailty (Table 5).

## DISCUSSION

Our findings identified factors related to incidence of depressed mood and that of frailty during the COVID-19 pandemic. Factors related to incidence of depression were subjective memory impairment and difficulty in device usage, and factors related to incidence of frailty were being older, subjective memory impairment, lack of emotional social support, poor subjective health, and difficulty in social participation. Of these factors, subjective memory impairment correlated with both new depressed mood and new frailty. Older people with subjective memory impairment may be a high-risk group for depressed mood and frailty during this pandemic.

We found that the incidence of depressed mood and frailty over a 2-year period that included the COVID-19 pandemic were 25% and 11%, respectively. Because we had no control group, we could not differentiate the effect of the COVID-19 pandemic from the effect of time-dependent factors (e.g., the normal ageing process). However, the incidence of depressed mood (i.e., 25%) over 2 years was higher than the previously reported 3-year incidence of depressive symptoms (of approximately 16%).<sup>11</sup> In addition, participants in the previous study<sup>11</sup> (like

those in the present study) were community residents aged 65 years or older who were not receiving long-term care. However, our study was conducted in metropolitan Tokyo, whereas the previous study sampled participants from 40 local government administrative divisions.

We found a slightly higher incidence of frailty (i.e., 11%) over 2 years than the 5-year frailty incidence of 8% previously reported for older adults aged 65–70 years.<sup>14</sup> This difference warrants careful interpretation, because the participants and the observation periods were not identical between the two surveys. Our survey was conducted in the first 2 months after the government declared a state of emergency and people started practising social distancing; hence, the effect of social distancing on frailty may not have been fully accounted for.

The social costs of depression and frailty are heavy. Although the costs of depression and frailty in older people are unclear, the total cost of depression in Japan is 2 trillion yen (equivalent to 18 billion USD).<sup>28</sup> There seem to be no figures for the total societal cost of frailty. However, individual-level increases in care costs have been reported in Japan<sup>29</sup> and Germany.<sup>30</sup> The present findings suggest that the COVID-19 pandemic may cause a substantial long-term social burden through its effect on depressed mood.

Social distancing is a reasonable strategy to combat COVID-19, but it is crucial for older persons to maintain social connections to reduce depressed mood and frailty. Humans are social beings, despite differences in nationality and cultural background, and social distancing may cause substantial psychological distress; therefore, it is important to clarify the effect of social distancing on short- and long-term mental health.<sup>31</sup> A narrative review that included several cross-sectional descriptive studies reported a depression prevalence ranging from 15% to 47% during the COVID-19 pandemic.<sup>32</sup> According to Puccinelli et al.,<sup>33</sup> physical activity level during the period of social distancing was lower than that prior to the pandemic period. They also reported a bidirectional effect of depression and physical inactivity, which suggests that social distancing is associated with a large increase in physical and mental vulnerability.

To address this adverse effect of social distancing, one potential solution is the use of remote tools, which can help frail older people maintain social connections.<sup>34</sup> As many older people are unfamiliar with modern communication tools like social network



services or email, the use of more traditional devices like telephones may be preferable. For example, we have started a telephone outreach service for frail older people in a large housing complex in another area of Tokyo, which has proved effective.<sup>35</sup>

Immediate action to help older people worldwide is essential. However, the construction of a systematic telephone outreach network for older people with memory impairment is more difficult during a pandemic. Our experience with a community-based participatory research framework<sup>36,37</sup> indicates that building networks for isolated older people takes time and effort in the real world. We overcame this difficulty by ensuring that specialists such as doctors, psychologists, and public health nurses develop face-to-face relationships with residents or community workers over a period of years. A useful strategy would be to focus on building age-friendly communities and to maintain an effective outreach network to prepare individuals, especially frail older people, for future crisis situations. AGE Platform Europe<sup>38</sup> recommends extending the scope of the ‘reasonable accommodation’ concept beyond disability and including older persons. In the current ‘super-aged society’, specific interventions are needed to protect frail older people (who are easily isolated from society and experience depressed mood and frailty) without compromising their freedom.

Finally, long-term studies suggest that disasters have a lasting effect on the mental health of victims.<sup>39,40</sup> Future studies are needed to identify the long-term influence of COVID-19.

## STRENGTHS AND LIMITATIONS

A strength of this study is that it was conducted during the national state of emergency (i.e., April and May, 2020). This was possible because of the 10 years of cooperation and trust building between the research team and local government. In addition, as we used pre-existing questionnaires, the study did not disrupt essential government work. Accordingly, we could reveal the incidence of depression and frailty during the COVID-19 pandemic.

This study had some limitations. First, as mentioned above, we lacked a control group. This is a major study limitation. Second, this was a self-report mail survey and we did not collect objective data. Third, depressed mood was defined using the KCL.

Although the frailty assessed by KCL is reported to be adequate for cross-cultural studies,<sup>23</sup> depressed mood assessed by KCL has not been sufficiently validated enough. However, because the KCL is used universally in the Japanese public sector and this was a local government survey, we used and analysed KCL data. We also need to establish the equivalence of KCL defined depressed mood with widely used measures such as the Geriatric Depression Scale<sup>9</sup> to share the research outcome with the world. Fourth, older people certified on the LTCI scheme, who may constitute the highest-risk group, were excluded from the survey. Fifth, nutritional status and physical performance play important roles in preventing depression and frailty, but they were not analysed in this study.

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