Association between work-related changes caused by the COVID-19 pandemic and severe psychological distress among Japanese workers

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Abstract: This study aimed to evaluate the association between work-related changes caused by COVID-19 and psychological distress among Japanese workers. The cross-sectional study was conducted from August 25 to September 30, 2020. The participants were 15,454 employees who were registered as panelists with an online survey company. The Kessler psychological distress scale with a 13-point cutoff was used to measure psychological distress. Multiple logistic regression was performed. Of the respondents, 8.9% were evaluated as having severe psychological distress. Among five examined work-related changes, being laid off and changing jobs (adjusted odds ratio [aOR] = 5.43; 95% confidence interval [CI]: 4.18–7.05), experiencing temporary workplace closure (aOR = 1.94; 95% CI: 1.67–2.25), being forced to visit the workplace for paperwork (aOR = 1.84; 95% CI: 1.58–2.15), and starting telework from home (aOR = 1.18; 95% CI: 1.01–1.37) were associated with increased psychological distress; no significant association was found for participation in work-related online meetings. The impact on psychological distress was greater among men, especially for being laid off and changing jobs because of COVID-19. It is important to assess and reduce negative mental health effects among workers experiencing work-related changes caused by the COVID-19 pandemic, taking gender differences into account.

Key words: COVID-19, Mental disorder, Occupational health, Psychological distress, Worker

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has significantly impacted the employment and work style of workers. COVID-19 is an infectious respiratory disease caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) pathogen\textsuperscript{1,2}. It was first reported in Wuhan, China, in December 2019; since then, more than 35 million people have been infected, resulting in more than one million deaths by September 2020\textsuperscript{3}. Many countries have introduced various measures severely limiting outdoor and economic activities to prevent the spread of
COVID-19. A state of emergency was declared for all of Japan in April and May 2020. In addition to recommending self-restraint in holding events and outdoor activities, companies were requested to reduce the number of workers commuting to the workplace by 70%6. As a result, work styles such as teleworking from home and online meetings have spread dramatically. However, companies where such measures could not be adopted have faced problems such as employee layoffs, temporary workplace closures, and employees being forced to visit the workplace for paperwork7. Japan experienced a second wave of COVID-19 in August 2020, but this second wave did not lead to the declaration of a state of emergency.

The COVID-19 pandemic has affected the mental health of workers. During the COVID-19 pandemic, many risk factors for psychological distress have been reported, including anxiety about the future, social isolation, low levels of interpersonal contact, and inadequate infection control measures at the workplace8. It has also been suggested that young people, women, individuals with chronic diseases, and workers in unstable employment are more susceptible than others to mental distress because of COVID-199, 10. A previous study in Japan reported that the number of suicides among women increased during the state of emergency11. However, little is known about the rapid changes in employment and work styles during the COVID-19 pandemic or the associated psychological distress among workers.

The COVID-19 pandemic has brought about dynamic changes in employment and work styles, and such changes are likely to affect workers’ mental health. For example, teleworking and online meetings have been reported to improve labor productivity12 but hinder workplace communication13. The effects of the rapid shift to teleworking and online meetings on workers’ psychological well-being have not been well evaluated. Moreover, as mentioned above, workers in workplaces where it is difficult to adopt teleworking or online meetings have faced problems such as being laid off and changing jobs, experiencing temporary workplace closures, and being forced to visit the workplace for paperwork. Although an evaluation of layoffs has been reported14, the associations between psychological distress and other problems during the COVID-19 pandemic, such as temporary workplace closures and employees being forced to visit the workplace for paperwork, have not been empirically assessed. Therefore, this study aimed to evaluate the associations between psychological distress and work-related changes caused by the COVID-19 pandemic.

Subjects and Methods

Design and data collection

This study was undertaken as part of the Japan “COVID-19 and Society” Internet Survey (JACSIS)15, a cross-sectional survey that was conducted using a self-report questionnaire to evaluate the health impacts and socioeconomic effects of COVID-19. The participants were approximately 2.2 million market research respondents who were registered as panelists with an online survey company (Rakuten Insight, Inc., Osaka). First, respondents were stratified by sex, age (5-year age bands), and region (47 prefectures), with the selection designed to match the population distributions according to the 2019 Comprehensive Survey of Living Conditions16. To allow for the expected low response rate, 224,389 respondents aged 15–79 years were randomly selected. During the period of August 25–September 30, 2020, e-mails containing the request for participation and a link to the website with the questionnaire were sent to the selected respondents. Recruitment was stopped when the target number of respondents in each stratum was reached. In total, responses were collected from 28,000 participants (response rate 12.5%). Subsequently, we excluded 10,028 respondents who reported not being employed and 2,518 respondents with invalid responses. Ultimately, the analysis was performed with data from 15,454 respondents who were currently working. At the beginning of the questionnaire, the participants were asked to provide informed consent, and only those who agreed were able to respond to the questionnaire. This study was approved by the Institutional Review Board of the Osaka International Cancer Institute (No. 20084) and the Ethics Committee of the University of Occupational and Environmental Health, Japan (R3-055).

Outcome

The Kessler psychological distress scale (K6) was used to measure psychological distress. The K6 was developed in the United States by Kessler et al. to screen patients with mental disorders17. The K6 has been translated into multiple languages for use in various countries, and the reliability and validity of the Japanese version have been confirmed18. The K6 comprises the following six questions: “During the past 30 days, about how often did you feel…”: (1) “…nervous?”; (2) “…hopeless?”; (3) “…restless or fidgety?”; (4) “…so depressed that nothing could cheer you up?”; (5) “…that everything was an effort?”; and (6) “…worthless?” Each of the questions has the following five response options: all the time (four points), most of the time...
(three points), some of the time (two points), a little of the
time (one point), and none of the time (zero points). The
points are added to calculate a total score with the range of
0 to 24. A higher score indicates more severe distress. Follow-
ning a previous study19, we considered a total score of 13
or more on the K6 scale to indicate severe psychological
distress.

Independent variables

Data on sex, age, annual household income, employment
status, job type, and the number of employees at the re-
spondent’s workplace were extracted from the question-
aire. Five variables representing work-related changes
were selected in discussion with epidemiologists, psychia-
trists, and occupational physicians in the JACSIS Project.
These variables were based on the government’s response
policy when COVID-19 began to spread in Japan and infor-
mation sources available at that time19. The following
questions were used to assess the five work-related chang-
es: “I was laid off and changed jobs because of COVID-19”,
“I experienced a temporary workplace closure because of
COVID-19”, “I was forced to visit the workplace for paper-
work (e.g., signing documents)”, “I started teleworking
from home”, and “I started participating in online meetings
related to work”. For the responses on each item, the op-
tions of yes, no, and not applicable were used.

Statistics

For the analysis, responses regarding work-related
changes caused by the COVID-19 pandemic were dichoto-
mized into yes and no categories, with not applicable re-
sponses considered no. First, descriptive statistics were
used to calculate the count (n) and percentage of each fac-
tor by the presence of severe psychological distress. Next,
we used the chi-square test and multiple logistic regression
to assess the relationships between work-related changes
casted by the COVID-19 pandemic and severe psychological
distress. The adjustment variables of sex, age, house-
hold income, employment status, job type, and number of
employees at the workplace were included. A sub-analysis
using multiple logistic regression adjusting for age was
performed to elucidate sex differences in the associations
between work-related changes caused by the COVID-19
pandemic and severe psychological distress. Sex was not
treated as an adjusted factor, but a sex-stratified analysis
was conducted. p<0.05 was considered statistically signif-
ificant. A two-tailed test was performed. Stata/SE 16.1
(StataCorp, College Station, TX, USA) was used for all
analyses.

Results

The characteristics of the study participants are shown in
Table 1. Of the 15,454 participants, 58.3% were men, and
26.0% were in their 30s. Approximately half of the partici-
pants were permanent employees (56.0%), approximately
half were desk workers (48.6%), and 41.4% were employed
at workplaces with 1–49 employees. Of the respondents,
1.8% had been laid off and changed jobs because of
COVID-19, 11.5% had experienced a temporary workplace
closure because of COVID-19, 12.8% had been forced to
visit the workplace for paperwork, 18.1% had started tele-
working from home, and 23.2% had started participating in
online meetings related to work. The number of respon-
tsents classified as having severe psychological distress was
1,368 (8.9%), and Cronbach’s alpha for the K6 was 0.94 in
this study.

Table 2 shows the associations between work-related
changes caused by the COVID-19 pandemic and severe
psychological distress. The odds of severe psychological
distress were significantly higher for respondents who were
laid off and changed jobs because of COVID-19 compared
with those who continued working (adjusted odds ratio
[aOR] = 5.43; 95% confidence interval [CI]: 4.18–7.05). The odds of severe psychological distress were signifi-
cantly higher for respondents who experienced a temporary
workplace closure because of COVID-19 (aOR = 1.94;
95% CI: 1.67–2.25) and for those who were forced to visit
the workplace for paperwork (aOR = 1.84; 95% CI: 1.58–
2.15), compared with those without these respective expe-
riences. A comparison of respondents who had started tele-
working from home with those without such experience
showed a slight positive association (aOR = 1.18; 95% CI:
1.01–1.37). However, no significant association was found
for participation in work-related online meetings.

Table 3 displays the association between work-related
changes caused by the COVID-19 pandemic and severe
psychological distress by sex. For being laid off and chang-
ing jobs, the aOR was twice as high for men as for women
(men: aOR = 8.83, 95% CI: 6.21–12.55; women: aOR =
3.73, 95% CI: 2.52–5.52). The aOR for temporary work-
place closure was also slightly higher for men than for
women (men: aOR = 2.37, 95% CI: 1.93–2.91; women:
aOR = 1.73, 95% CI: 1.40–2.12). Conversely, sex differ-
ences were not found for being forced to visit the work-
place for paperwork (men: aOR = 1.67, 95% CI: 1.38–2.01;
women: aOR = 1.67, 95% CI: 1.33–2.10), and there were
no significant differences between men and women in the
effect of starting teleworking from home or the effect of
## Table 1. Characteristics of the study participants

|                          | Total  | Non-severe psychological distress | Severe psychological distress |
|--------------------------|--------|-----------------------------------|------------------------------|
|                          | \(n=15,454\) (100.0%) | \(n=14,086\) (91.1%) | \(n=1,368\) (8.9%) |
| **Sex**                  |        |                                   |                              |
| Men                      | 9,008  (58.3) | 8,250 (58.6) | 758 (55.4) |
| Women                    | 6,446  (41.7) | 5,836 (41.4) | 610 (44.6) |
| **Age (years)**          |        |                                   |                              |
| 15–29                    | 2,326  (15.1) | 1,965 (14.0) | 361 (26.4) |
| 30–39                    | 3,024  (19.6) | 2,676 (19.0) | 348 (25.4) |
| 40–49                    | 4,021  (26.0) | 3,635 (25.8) | 386 (28.2) |
| 50–59                    | 3,301  (21.4) | 3,093 (22.0) | 208 (15.2) |
| \(\geq 60\)             | 2,782  (18.0) | 2,717 (19.3) | 65 (4.8)  |
| **Annual household income (yen)** |        |                                   |                              |
| \(\geq 8,000,000\)      | 3,817  (24.7) | 3,337 (23.7) | 480 (35.1) |
| 6,000,000–7,999,999      | 3,279  (21.2) | 3,001 (21.3) | 278 (20.3) |
| 4,000,000–5,999,999      | 2,349  (15.2) | 2,166 (15.4) | 183 (13.4) |
| \(< 4,000,000\)         | 3,522  (22.8) | 3,281 (23.3) | 241 (17.6) |
| Unknown                  | 2,487  (16.1) | 2,301 (16.3) | 186 (13.6) |
| **Employment status**    |        |                                   |                              |
| Permanent employee       | 8,666  (56.0) | 7,896 (56.1) | 770 (56.3) |
| Owner                    | 847    (5.5)  | 761 (5.4)   | 86 (6.3)   |
| Temporary employee       | 1,338  (8.7)  | 1,224 (8.7) | 114 (8.3)  |
| Part-time employee       | 2,870  (18.6) | 2,626 (18.6) | 244 (17.4) |
| Self-employed            | 1,733  (11.2) | 1,579 (11.2) | 154 (11.3) |
| **Job type**             |        |                                   |                              |
| Physical work            | 4,163  (26.9) | 3,825 (27.2) | 338 (24.7) |
| Desk work                | 7,498  (48.6) | 6,821 (48.4) | 677 (49.5) |
| Other                    | 3,793  (24.5) | 3,440 (24.4) | 353 (25.8) |
| **Number of employees at the workplace (persons)** |        |                                   |                              |
| 1–49                     | 6,402  (41.4) | 5,886 (41.8) | 516 (37.7) |
| 50–299                   | 3,564  (23.1) | 3,226 (22.9) | 338 (24.7) |
| 300–999                  | 1,929  (12.5) | 1,732 (12.3) | 197 (14.4) |
| \(\geq 1,000\)          | 3,559  (23.0) | 3,242 (23.0) | 317 (23.2) |
| **Being laid off and changing jobs because of COVID-19** | 278 (1.8) | 174 (1.2) | 104 (7.6) |
| Experiencing a temporary workplace closure because of COVID-19 | 1,782 (11.5) | 1,507 (10.7) | 275 (20.1) |
| **Being forced to visit the workplace for paperwork** | 1,975 (12.8) | 1,707 (12.1) | 268 (19.6) |
| **Starting teleworking from home** | 2,799 (18.1) | 2,517 (17.9) | 282 (20.6) |
| **Starting participation in online meetings related to work** | 3,580 (23.2) | 3,251 (23.1) | 329 (24.0) |

COVID-19: coronavirus disease 2019
This percentage was similar to the percentages for severe psychological distress that has been reported in nation-wide studies in Japan (8.4%–9.1%)\(^2\)\(^,\)\(^3\). Our study also had the novel finding that the experience of being laid off and changing jobs and the experience of a temporary workplace closure was statistically associated with psychological distress. These trends were more prominent among men than among women. Job stability is important for reducing psychological distress of workers during the COVID-19 pand-

### Table 2. Associations between work-related changes caused by the COVID-19 pandemic and severe psychological distress

|                        | Severe psychological distress | Univariate | Adjusted* |
|------------------------|------------------------------|------------|-----------|
|                        | n (%)                        | OR (95% CI) | p value   | OR (95% CI) | p value   |
| Being laid off and changing jobs because of COVID-19 |                             |            |           |            |           |
| No                     | 1,264 (8.3)                  | 1.00       | -         | 1.00       | -         |
| Yes                    | 104 (37.4)                   | 6.58       | (5.13–8.44) | <0.001     | 5.43       | (4.18–7.05) | <0.001 |
| Experiencing a temporary workplace closure because of COVID-19 |                             |            |           |            |           |
| No                     | 1,093 (8.0)                  | 1.00       | -         | 1.00       | -         |
| Yes                    | 275 (15.4)                   | 2.10       | (1.82–2.42) | <0.001     | 1.94       | (1.67–2.25) | <0.001 |
| Being forced to visit the workplace for paperwork |                             |            |           |            |           |
| No                     | 1,100 (8.2)                  | 1.00       | -         | 1.00       | -         |
| Yes                    | 268 (13.6)                   | 1.77       | (0.53–2.04) | <0.001     | 1.84       | (1.58–2.15) | <0.001 |
| Starting teleworking from home |                             |            |           |            |           |
| No                     | 1,086 (8.6)                  | 1.00       | -         | 1.00       | -         |
| Yes                    | 282 (10.1)                   | 1.19       | (1.04–1.37) | 0.012      | 1.18       | (1.01–1.37) | 0.032 |
| Starting participation in online meetings related to work |                             |            |           |            |           |
| No                     | 1,039 (8.8)                  | 1.00       | -         | 1.00       | -         |
| Yes                    | 329 (9.2)                    | 1.05       | (0.93–1.20) | 0.417      | 1.03       | (0.89–1.19) | 0.696 |

COVID-19: coronavirus disease 2019; OR: odds ratio; CI: confidence interval

*Adjusted for sex, age, household income, employment status, job type, and the number of employees at the workplace.

### Table 3. Associations between work-related changes caused by the COVID-19 pandemic and severe psychological distress by sex

|                        | Men (n=9,008) | Women (n=6,446) |
|------------------------|---------------|-----------------|
|                        | Severe psychological distress | Age-adjusted | Severe psychological distress | Age-adjusted |
|                        | n (%) | OR (95% CI) | p value | n (%) | OR (95% CI) | p value |
| Being laid off and changing jobs because of COVID-19 |     |            |         |     |            |         |
| No                     | 692 (7.8) | 1.00       | -       | 572 (9.1) | 1.00       | -       |
| Yes                    | 66 (45.2) | 8.83       | (6.21–12.55) | <0.001 | 38 (28.8) | 3.73       | (2.52–5.52) | <0.001 |
| Experiencing a temporary workplace closure because of COVID-19 |     |            |         |     |            |         |
| No                     | 619 (7.6) | 1.00       | -       | 474 (8.6) | 1.00       | -       |
| Yes                    | 139 (16.8) | 2.37       | (1.93–2.91) | <0.001 | 136 (14.3) | 1.73       | (1.40–2.12) | <0.001 |
| Being forced to visit the workplace for paperwork |     |            |         |     |            |         |
| No                     | 594 (7.7) | 1.00       | -       | 506 (8.8) | 1.00       | -       |
| Yes                    | 164 (12.8) | 1.67       | (1.38–2.01) | <0.001 | 104 (14.9) | 1.67       | (1.33–2.10) | <0.001 |
| Starting teleworking from home |     |            |         |     |            |         |
| No                     | 587 (8.2) | 1.00       | -       | 499 (9.1) | 1.00       | -       |
| Yes                    | 171 (9.2) | 1.04       | (0.87–1.25) | 0.072 | 111 (11.7) | 1.18       | (0.95–1.47) | 0.143 |
| Starting participation in online meetings related to work |     |            |         |     |            |         |
| No                     | 555 (8.6) | 1.00       | -       | 484 (9.0) | 1.00       | -       |
| Yes                    | 203 (8.0) | 0.87       | (0.73–1.03) | 0.099 | 126 (11.9) | 1.19       | (0.96–1.47) | 0.105 |

COVID-19: coronavirus disease 2019; OR: odds ratio; CI: confidence interval

*Adjusted for sex, age, household income, employment status, job type, and the number of employees at the workplace.

starting to participate in online meetings related to work.

**Discussion**

This study evaluated the associations between work-related changes caused by the COVID-19 pandemic and severe psychological distress among Japanese workers. Our findings revealed that approximately 8.9% of the respondents were experiencing severe psychological distress. This percentage was similar to the percentages for severe psychological distress that has been reported in nation-wide studies in Japan (8.4%–9.1%)\(^2\)\(^,\)\(^3\). Our study also had the novel finding that the experience of being laid off and changing jobs and the experience of a temporary workplace closure was statistically associated with psychological distress. These trends were more prominent among men than among women. Job stability is important for reducing psychological distress of workers during the COVID-19 pan-
emic, especially among men. In addition, the experiences of being forced to visit the workplace for paperwork and starting teleworking from home were associated with higher levels of psychological distress. However, we did not find any association between psychological distress and beginning to participate in online meetings. We believe that these findings are important in identifying target populations in need of psychological assistance and intervention programs.

The results of this study showed that both the experience of being laid off and changing jobs and the experience of a temporary workplace closure were associated with psychological distress. This finding is in line with a previous study in the United States\(^\text{22}\) that suggested that addressing insecure employment is critical in minimizing suicide during the COVID-19 pandemic. Importantly, we found that the associations between work-related changes caused by COVID-19 and psychological distress were more prominent among Japanese men than among their female counterparts. Mixed results have been reported in past studies comparing the psychological effects of workplace stressors on men and women\(^\text{11, 23}\). The number of suicides has been shown to have increased after the state of emergency declaration in Japan, especially among women\(^\text{11}\). Additionally, a previous study found that female workers have greater anxiety about unemployment during organizational downsizing compared with male workers, even if they escape layoffs; accordingly, the onset of major depression increases at a higher rate for these women than for their male colleagues\(^\text{21}\). However, in Japan, men are more likely than women to support their families financially; therefore, the impact of insecure employment on suicide is greater among men than among women in this context\(^\text{24}\). Substantial gender differences have also been shown in perceptions of risk for contracting COVID-19\(^\text{25}\). Although social support is important for people who have lost their jobs, public support to prevent organizational downsizing and to sustain employment are also crucial, while considering the different demographic of men and women.

The present survey found that severe psychological distress is associated with being forced to visit the workplace for paperwork. Jobs can be divided into two types: those where the time and place of the work are difficult to adjust and there is little flexibility, and those where the time and place of the work are flexible. Regardless of the type of job, however, many workers have been forced to commute to their workplaces because of the lack of the necessary infrastructure for telework and the difficulty of managing employee attendance. For example, some temporary workers have had to commute to their workplaces because teleworking was allowed only for permanent workers\(^\text{26}\). For workers forced to visit the workplace during the COVID-19 pandemic, it is necessary to eliminate such discrimination in the workplace and to reduce the psychological burden by introducing flexible work styles in addition to support\(^\text{27}\).

We found no significant association between psychological distress and beginning participation in online meetings and a slightly positive association between starting teleworking from home and psychological distress. Therefore, participating in online meetings does not cause psychological distress, but the loneliness arising from working alone and the work environment at home are considered stressful. A previous study reported that the feeling of loneliness is higher in young people living alone during the COVID-19 pandemic\(^\text{28}\). Furthermore, teleworking from home has been shown to reduce the frequency of communication in the workplace\(^\text{13}\). Other studies have also reported that teleworking from home increases job demands, thereby causing problems such as sleep disorders, which negatively affect workers’ mental health\(^\text{29, 30}\). Our findings that starting teleworking from home was associated with psychological distress but that participating in online meetings was not indicate that it is necessary to distinguish the challenges of teleworking from online meetings and other challenges such as loneliness and work environment.

This study has several limitations. First, because the study was cross-sectional, causality was not evaluated. Second, sampling bias should be considered because an Internet survey was used. For example, people with high psychological distress may not have been able to participate in the survey. Additionally, the response rate in this study was rather low (12.5%), and the results should be interpreted carefully because of the healthy worker effect. Third, the study period used in this study should be considered with caution. Psychological distress was evaluated during August and September 2020 in the current study, and the situation might be different in other periods, such as during the state of emergency in April and May 2020. For example, for some respondents who started teleworking, their psychological distress may have gradually decreased, whereas it may have increased for others in the same situation. Finally, the current study did not include people who were unemployed during the study period. This may have weakened the results for psychological distress, especially among those who experienced layoffs or job changes.

In conclusion, the associations between work-related changes caused by COVID-19 and psychological distress were evaluated in this study. The findings confirmed that
being laid off and changing jobs, experiencing a temporary workplace closure, being forced to visit the workplace for paperwork, and starting teleworking from home were associated with psychological distress. The impact on psychological distress was greater in men than in women, especially for those being laid off and changing jobs because of COVID-19. Conversely, no significant differences in psychological distress were found by participation in work-related online meetings. The results suggest that most work-related changes caused by the COVID-19 pandemic have likely had negative effects on workers’ mental health, particularly among men. Therefore, it is important to assess and reduce mental health problems among workers experiencing work-related changes caused by the COVID-19 pandemic, while taking gender differences into account.

Conflict of interest

The authors declare no conflict of interest.

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References

1) Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, Si HR, Zhu Y, Li B, Huang CL, Chen HD, Chen J, Luo Y, Guo H, Jiang RD, Liu MQ, Chen Y, Shen XR, Wang X, Zheng XS, Zhao K, Chen QJ, Deng F, Liu LL, Yan B, Zhan FX, Wang YY, Xiao GF, Shi ZL (2020) A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 579, 270–3.

2) Chen Y, Klein SL, Garibaldi BT, Li H, Wu C, Osevala NM, Li T, Margolick JB, Pawelec G, Leng SX (2021) Aging in COVID-19: vulnerability, immunity and intervention. Ageing Res Rev 65, 101205.

3) World Health Organization. WHO Coronavirus(COVID-19) Dashboard. https://covid19.who.int/. Accessed March 11, 2021.

4) Blavatnik School of Government, University of Oxford. COVID-19 Government Response Tracker. https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker. Accessed March 11, 2021.

5) Pan A, Liu L, Wang C, Guo H, Hao X, Wang Q, Huang J, He N, Yu H, Lin X, Wei S, Wu T (2020) Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA 323, 1915–23.

6) Shimizu K, Negita M (2020) Lessons learned from Japan’s response to the first wave of COVID-19: a content analysis. Healthcare (Basel) 8, 426.

7) Kiuchi K, Kishi K, Araki K (2020) A foundational assessment of the effects of the spread of COVID-19 virus infection and related activity restrictions on mental and physical health, psychological distress, and suicidalideation in Japan. Asia Pac J Public Health 32, 463–6.

8) Giorgi G, Lecca LI, Alessio F, Finstad GL, Bondanini G, Lulli LG, Arcangeli G, Mucci N (2020) COVID-19-related mental health effects in the workplace: a narrative review. Int J Environ Res Public Health 17, 7857.

9) Ahmed MZ, Ahmed O, Aibao Z, Hanbin S, Siyu L, Ahmad A (2020) Epidemic of COVID-19 in China and associated psychological problems. Asian J Psychiatr 51, 102092.

10) Xiao Y, Becerik-Gerber B, Lucas G, Roll SC (2021) Impacts of working from home during COVID-19 pandemic on physical and mental well-being of office workstation users. J Occup Environ Med 63, e12211.

11) Ishimaru T, Fujino Y (2021) Association between work style and presenteeism in the Japanese service sector. J Occup Health 63, 181–90.

12) Ikeda T, Igarashi A, Odani S, Murakami M, Tabuchi T (2021) Health-related quality of life during COVID-19 pandemic: assessing impacts of job loss and financial support programs in Japan. Appl Res Qual Life, doi: 10.1007/s11482-021-09918-6. Online ahead of print.

13) Ministry of Health, Labour and Welfare (2019) Comprehensive Survey of Living Conditions, Health and Welfare Statistics Association, Tokyo.

14) Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, Walters EE, Zaslavsky AM (2002) Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 32, 959–76.

15) Ministry of Health, Labour and Welfare (2019) Comprehensive Survey of Living Conditions, Health and Welfare Statistics Association, Tokyo.

16) Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, Walters EE, Zaslavsky AM (2002) Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 32, 959–76.

17) Furukawa TA, Kawakami N, Saitoh M, Ono Y, Nakane Y, Nakamura Y, Tachimori H, Iwata N, Uda H, Nakane H, Watanabe M, Naganuma Y, Hata Y, Kobayashi M, Miyake Y, Takeshima T, Kikkawa T (2008) The performance of the Japanese version of the K6 and K10 in the World Mental Health Surveys. Int J Methods Psychiatr Res 17, 207–215.
18) Kessler RC, Barker PR, Colpe LJ, Epstein JF, Gfroerer JC, Hiripi E, Howes MJ, Normand SL, Manderscheid RW, Walters EE, Zaslavsky AM (2003) Screening for serious mental illness in the general population. Arch Gen Psychiatry 60, 184–9.

19) Prime Minister of Japan and His Cabinet. The Second Novel Coronavirus Disease (COVID-19) Emergency Response Package (Key Points). http://japan.kantei.go.jp/ongoingtopics/_00015.html. Accessed July 1, 2021.

20) Fujino Y, Ishimaru T, Eguchi H, Tsuji M, Tateishi S, Ogami A, Mori K, Matsuda S (2021) Protocol for a nationwide internet-based health survey of workers during the COVID-19 pandemic in 2020. J UOEH 43, 217–25.

21) Sugimoto T, Umeda M, Shinozaki T, Naruse T, Miyamoto Y (2015) Sources of perceived social support associated with reduced psychological distress at 1 year after the Great East Japan Earthquake: nationwide cross-sectional survey in 2012. Psychiatry Clin Neurosci 69, 580–6.

22) Brenner MH, Bhugra D (2020) Acceleration of anxiety, depression, and suicide: secondary effects of economic disruption related to COVID-19. Front Psychiatry 11, 592467.

23) Junna L, Moustgaard H, Huttunen K, Martikainen P (2020) The association between unemployment and mortality: a cohort study of workplace downsizing and closure. Am J Epidemiol 189, 698–707.

24) Koo J, Cox WM (2008) An economic interpretation of suicide cycles in Japan. Contemp Econ Policy 26, 162–74.

25) Ishimaru T, Okawara M, Ando H, Hino A, Nagata T, Tateishi S, Tsuji M, Matsuda S, Fujino Y (2021) Gender differences in the determinants of willingness to get the COVID-19 vaccine among the working-age population in Japan. Hum Vaccin Immunother 17, 3975–81.

26) Meijer AC, William RW, Bannister F, Bennett CJ, Chen K, Choi H, Criado JI, Cunha MA, Demircioglu MA, Gasco-Hernandez M, Henman P, Kimemia D, Lember V, Löfgren K, Luna-Reyes LF, Mergel I, Murakami Wood D, Nesti G, Przybilovicz E, Raghavan A, Svenonius O, van Brakel R, Yildiz M (2020) The COVID-19-crisis and the information polity: an overview of responses and discussions in twenty-one countries from six continents. Information Polity 25, 243–74.

27) Chew QH, Wei KC, Vasoo S, Chua HC, Sim K (2020) Narrative synthesis of psychological and coping responses towards emerging infectious disease outbreaks in the general population: practical considerations for the COVID-19 pandemic. Singapore Med J 61, 243–74.

28) Brenner MH, Bhugra D (2020) Acceleration of anxiety, depression, and suicide: secondary effects of economic disruption related to COVID-19. Front Psychiatry 11, 592467.

29) Groarke JM, Berry E, Graham-Wisener L, McKenna-Plumley PE, McGlinchey E, Armour C (2020) Loneliness in the UK during the COVID-19 pandemic: cross-sectional results from the COVID-19 psychological wellbeing study. PLoS One 15, e0239698.

30) Koo J, Cox WM (2008) An economic interpretation of suicide cycles in Japan. Contemp Econ Policy 26, 162–74.