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# BMJ Open

## Disrupted care during the COVID-19 state of emergency and subsequent presenteeism in workers: a nationwide cross-sectional study

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3 **Disrupted care during the COVID-19 state of emergency and subsequent**  
4 **presenteeism in workers: a nationwide cross-sectional study**  
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51 Main text 2288 words, abstract 285 words, 28 references, 0 figures and 3 tables.  
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## Abstract

**Objectives:** The coronavirus disease 2019 (COVID-19) pandemic has influenced delay and avoidance of medical care around the globe. Many chronic diseases are associated with the phenomenon of presenteeism in the workforce, but little is known about the relationship between disrupted care and presenteeism. We aimed to investigate whether disrupted care during the COVID-19 state of emergency was associated with subsequent presenteeism.

**Setting:** We used data from a nationwide cross-sectional internet-based self-administered survey.

**Participants:** 14,545 participants who answered that they were currently employed.

**Primary and secondary outcome measures:** We performed multiple logistic regression analysis to investigate the association between presenteeism and variables related to disrupted care during the COVID-19 state of emergency.

**Methods:** We used data from a nationwide cross-sectional internet-based self-administered survey. We performed multiple logistic regression analysis on data from 14,545 participants to investigate the association between presenteeism and variables related to disrupted care during the COVID-19 state of emergency.

**Results:** After adjusting for demographic factors, participants who experienced disrupted care were more likely to show presenteeism. Presenteeism was also somewhat associated with chronic illnesses even where care was not disrupted. After adjusting for each variable related to disrupted care, exacerbation of underlying disease, disruptions in non-routine clinical settings and running out of drugs were all positively associated with presenteeism. However, disruptions in routine clinical settings showed no association with presenteeism.

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3 **Conclusions:** Disrupted care was strongly associated with presenteeism. Because of the  
4 gap between the results of adjusted models, exacerbation of underlying disease was  
5 considered to be one pathway by which disrupted care can affect presenteeism. Timely  
6 care for acute illness and support for continued medication for chronic diseases during  
7 health emergencies would be helpful to reduce subsequent presenteeism among those  
8 with chronic illnesses.  
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12 **Key words:** COVID-19; epidemiology; health resource management; occupational &  
13 industrial health  
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### Strengths and limitations of this study

This study revealed an occupational health problem emerging during the pandemic, and drew on a large sample of nationwide data.

It used a cross-sectional design, so causality between disrupted care and presenteeism cannot be established.

We did not specify which underlying disease was associated with disrupted care.

For peer review only

## Introduction

Presenteeism is the phenomenon of attending work despite being ill. It is a global challenge for organizations because it affects workers' productivity and future sickness absence.<sup>1)</sup> Aronsson *et al.* defined presenteeism as “people, despite complaints and ill health that should prompt rest and absence from work, still turning up at their jobs”.<sup>2)</sup> In Japan, the economic burden of presenteeism is estimated to be six times higher than that of sickness absence (3,055 USD vs 520 USD per person per year).<sup>3)</sup> Presenteeism is also associated with an increased risk of occupational injuries because of human error.<sup>4, 5)</sup> There is extensive evidence that various chronic diseases are associated with presenteeism, including heart disease, depression, diabetes, and low back pain.<sup>6, 7)</sup> It is therefore important to support early diagnosis and continuous treatment for ill health among workers.

The coronavirus disease 2019 (COVID-19) pandemic has influenced delay and avoidance of medical care around the globe.<sup>8-12)</sup> Morbidity and mortality associated with COVID-19 in Japan are the lowest in developed countries. A state of emergency was declared on 7th April 2020 for a specific region, and then expanded to the whole country between 16th April and 25th May 2020.<sup>13)</sup> All citizens were asked to cancel non-essential visits and stay at home during this period. The Japanese government did not implement a “lockdown” (city blockade) like many other countries, but this non-compulsory measure had a major impact on human movement.<sup>14)</sup> For example, using the nationwide prescription database, the volume of otolaryngology prescriptions decreased by 55% and the number of days of medication per prescription increased by 140% compared with the same period in 2019.<sup>15)</sup>



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3 Reduced access to care during the state of emergency may have influenced workers'  
4 subsequent health and therefore presenteeism. A previous study reported that the  
5 COVID-19 pandemic has had an indirect effect on excess deaths from chronic diseases  
6 because of the temporary disruption to care.<sup>16)</sup> Another study revealed that job insecurity  
7 related to the pandemic was strongly associated with attending work despite being ill.<sup>17)</sup>  
8 Many underlying diseases are associated with presenteeism,<sup>6, 7)</sup> but little is known about  
9 the relationship between disrupted care and presenteeism. We aimed to investigate  
10 whether disrupted care during the COVID-19 state of emergency was associated with  
11 subsequent presenteeism in workers. Our study provides evidence of the importance of  
12 early diagnosis and continuous treatment of non-COVID-19 patients to enable them to  
13 remain healthy and continue to work during a pandemic.  
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## 30 **Methods**

### 31 **Study design and participants**

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33 This study used data from the Japan “COVID-19 and Society” Internet Survey (JACSIS).  
34 This was a nationwide cross-sectional internet-based survey. Self-administered  
35 questionnaires were answered anonymously between 25th August and 30th September  
36 2020. The accessible population was panelists aged 15 to 79 years who were registered  
37 with an internet research company (approximately 2.2 million people). Simple random  
38 sampling was used to select a survey population of 223,389 who were invited to complete  
39 the survey via e-mail. We recruited participants in clusters by sex, age and prefecture  
40 based on national representative statistics,<sup>18)</sup> and ceased the recruitment after a sample  
41 of 28,000 had been collected (response rate 12.5%). We excluded 10,028 respondents  
42 who answered that they were currently unemployed and 2,518 respondents who gave  
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3 invalid responses, leaving 15,454 respondents eligible for analysis.  
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## 6 7 Outcome

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10 The main study outcome was presenteeism, measured using the Work Functioning  
11 Impairment Scale (WFun).<sup>19)</sup> This was originally developed in Japan and showed good  
12 correlation with other presenteeism instruments.<sup>19-21)</sup> It has two main points: linear rating  
13 scales on the Rasch model<sup>22)</sup> and proper measurement properties according to the  
14 guideline of consensus-based standards for the selection of health measurement  
15 instruments.<sup>23)</sup> The WFun contains seven items. Each question asks about experience “in  
16 the last 30 days”, meaning that we measured presenteeism during August and September  
17 2020 (3 months after the COVID-19 state of emergency was eased). For each question,  
18 respondents selected from five options, scoring 1 to 5 points. The total score therefore  
19 ranged from 7 to 35 points. Higher scores indicate worse presenteeism.  
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## 35 Independent variables

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37 We asked about four events related to disrupted care during the COVID-19 state of  
38 emergency (April to May 2020):  
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- 40 1) exacerbation of underlying disease;
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- 42 2) disruptions in non-routine clinical settings;
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- 44 3) running out of drugs; and
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- 46 4) disruptions in routine clinical settings.
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51 The items related to each variable were: “My underlying disease got worse”, “I could not  
52 see a doctor for unexpected symptoms or illnesses”, “I ran out of routine drugs”, and “I  
53 could not see a doctor as scheduled”. Responses were chosen from the three options:  
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3 “Yes”, “No” and “Not applicable”, which we translated as “illness with event”, “illness  
4 without event”, and “no illness”.  
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#### 8 9 10 Adjusted variables

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12 We collected demographic information about sex, age, annual household income,  
13 employment pattern, labor type and underlying disease from questionnaire data. One  
14 million Japanese yen was converted to 9,174 USD using 2019 rates.<sup>24)</sup> Employment  
15 pattern included permanent employee, company executive, temporary employee, part-  
16 time employee and self-employed. Labor type was categorized into manual work, desk  
17 work and other. We also asked about 16 types of illness such as hypertension, diabetes,  
18 and asthma (listed in Table 1).  
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#### 30 31 Statistical analysis

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33 The WFun score was classified into two groups in line with a previous study<sup>25)</sup>: From 7 to  
34 20 points was considered to be low presenteeism and 21 to 35 points as high. Univariate  
35 and multiple logistic regression analyses were used to investigate the association  
36 between variables related to disrupted care during the COVID-19 state of emergency and  
37 the WFun score of subsequent presenteeism. Two adjusted models were evaluated. The  
38 first model adjusted for demographic factors (sex, age, household income, employment  
39 pattern, labor type, and underlying disease). The second model also adjusted for each  
40 variable related to disrupted care. All P-values were two sided and considered statistically  
41 significant at  $P < 0.05$ . All analyses used Stata/SE 16.1 (StataCorp, College Station, TX,  
42 USA).  
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## Patient and public involvement

The participants and public were not involved in the design, conduct, reporting, and dissemination plans of our research.

## Results

Table 1 shows demographic characteristics of the participants. Of 14,545 participants, the majority were men (58.3%), permanent employees (56.0%), and desk workers (48.6%). The most frequent underlying disease was hypertension (15.3%), followed by periodontal disease (11.9%), caries (10.9%), and chronic pain (10.1%).

Table 2 shows the number and proportion of each variable related to disrupted care and presenteeism. One-fifth of participants (19.4%) scored 21 to 35 points on the WFun scale, showing high presenteeism. In total, 431 participants (2.8%) reported that their underlying disease got worse, 723 (4.7%) that they could not see a doctor for unexpected symptoms or illnesses, and 560 (3.6%) ran out of routine drugs during the state of emergency. A total of 3,651 participants (23.6%) continued to see a doctor as scheduled, but 1,700 (11.0%) had their care disrupted.

Table 3 shows the association between each variable related to disrupted care and presenteeism. In the univariate analysis as well as model 1 (adjusted for demographic factors), participants who experienced any disrupted care variables were more likely to show high presenteeism. Presenteeism was also somewhat associated with having a chronic disease even when care was not disrupted (all  $P < 0.001$ ). After adjusting for variables related to disrupted care in addition to demographic factors (model 2), a positive

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3 association with presenteeism was observed with exacerbation of underlying disease  
4 (adjusted Odds Ratio [aOR] = 2.02; 95% confidence interval [CI] 1.56–2.61), disruptions  
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6 (adjusted Odds Ratio [aOR] = 2.02; 95% confidence interval [CI] 1.56–2.61), disruptions  
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8 in non-routine clinical settings (aOR = 1.71; 95% CI 1.40–2.09) and running out of drugs  
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10 (aOR = 1.71; 95% CI 1.40–2.09). However, disruptions in routine clinical settings showed  
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12 no association with presenteeism in model 2.  
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## 17 **Discussion**

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19 This study evaluated association between disrupted care during the COVID-19 state of  
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21 emergency and subsequent presenteeism. As far as we can establish, it is one of the first  
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23 studies to provide evidence about an occupational health problem emerging from the  
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25 COVID-19 pandemic. In model 1, we found that workers who experienced any variables  
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27 related to disrupted care were much more likely to show subsequent presenteeism.  
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29 Presenteeism was associated with chronic illnesses even among workers whose care  
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31 continued. This suggests that early diagnosis and continuous treatment for ill health are  
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33 important for reducing presenteeism. It is possible that reduced accessibility of care for  
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35 non-COVID-19 patients during the COVID-19 pandemic may have contributed to reduced  
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37 productivity later.  
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44 We considered that exacerbation of underlying disease was one pathway by which  
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46 disrupted care could affect presenteeism. The gap between the results of our models 1  
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48 and 2, especially on disruptions in routine clinical settings, could be because exacerbation  
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50 of underlying disease affected the results of other variables in model 2. A global survey  
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52 reported that 24% of healthcare providers rated their disease management during the  
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54 COVID-19 pandemic as poor or very poor, and the mental health of over 80% of patients  
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3 got worse during the period.<sup>12)</sup> A previous study found that people with psychological  
4 complaints were at significantly higher odds of presenteeism, for example mental health  
5 problems (aOR = 20.45), malaise (aOR = 11.91) and sleeping problems (aOR = 8.62).<sup>20)</sup>  
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7 This evidence suggests that presenteeism may have been caused by health complaints  
8 resulting from poor disease management and mental health problems during the  
9 pandemic.  
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19 This study identified that unexpected symptoms or illnesses during the pandemic were  
20 associated with presenteeism, especially where care had been disrupted. The finding is  
21 consistent with a previous study of emergency department visits during the pandemic:  
22 delay and avoidance of medical care increased the death toll for people with non-COVID-  
23 19 acute illnesses.<sup>16)</sup> Approximately 12% of adults avoided or delayed seeking emergency  
24 care during the pandemic in the United States.<sup>11)</sup> In our study, participants who had  
25 experienced disruptions in non-routine clinical settings were relatively more likely to show  
26 later presenteeism than those who had seen a doctor (aOR = 1.71 vs 1.19 in model 2).  
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28 One possible reason is that self-diagnosis and triage tend to be associated with incorrect  
29 diagnosis and inappropriate treatment.<sup>26)</sup> These findings suggest it is important to receive  
30 timely care for acute illness regardless of possible infection during a pandemic.  
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47 Running out of drugs was also related to presenteeism, but disruptions in routine clinical  
48 settings were not. The finding about medication is consistent with a previous study of  
49 depression, which showed that depressed employees often experience long-term loss of  
50 work performance when they run out of drugs.<sup>27)</sup> Our study also demonstrated that  
51 disruptions in routine clinical settings showed no association in model 2, which adjusted  
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3 for exacerbation of underlying disease and relevant factors. Family doctors tried to extend  
4 patients' routine care visits during the COVID-19 pandemic whenever patients showed  
5 exacerbated clinical conditions.<sup>12)</sup> Postponement by family doctors therefore probably did  
6 not influence presenteeism. These findings suggest that support for continued medication  
7 and timely emergency care during health emergencies, rather than routine hospital visits,  
8 would help workers to avoid subsequent presenteeism. This might include telemedicine  
9 and drug delivery services.<sup>28)</sup>  
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21 This study had some limitations. It used a cross-sectional design, so causality between  
22 disrupted care and presenteeism cannot be established. To cope with this limitation, we  
23 asked about each issue using different time periods: experience of disrupted care during  
24 the COVID-19 state of emergency (April to May 2020) and presenteeism 3 months later  
25 (August and September 2020). However, recall bias may have been an issue. Workers  
26 who experienced disrupted care might be more likely to remember health problems, which  
27 may cause an overestimation of presenteeism. Another limitation is that we did not specify  
28 which underlying disease was associated with disrupted care. We adjusted for potential  
29 causes in the statistical analysis, but future studies should consider this issue to clarify  
30 the relationship between underlying diseases and disrupted care. Despite these  
31 limitations, this study revealed an occupational health problem emerging during the  
32 pandemic, and drew on a large sample of nationwide data.  
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51 In conclusion, our study showed that workers who experienced disrupted care were much  
52 more likely to show subsequent presenteeism. This finding suggests that disrupted care  
53 may influence workers' subsequent performance. Exacerbation of underlying disease is  
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3 one possible pathway by which disrupted care could affect presenteeism. Timely care for  
4 acute illness and support for continued medication for underlying diseases would be  
5 helpful to ensure that workers can continue to operate even during health crises. In future  
6 similar situations, increasing accessibility of care for patients, such as telemedicine and  
7 drug delivery service, could help.  
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### 17 **Contributors**

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19 TI conceived the research questions. TT designed the research protocol and collected  
20 data. TI conducted the statistical analysis and drafted the initial manuscript with YF. KT  
21 and AH revised the manuscript. All the authors read and approved the final manuscript.  
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### 47 **Conflict of Interest**

48  
49 YF has received research grants and/or personal fees from NTT DATA MSE Corp., The  
50 LOFT Co., Ltd., Sampo Health Support Inc., Asahi Shimbun Co., Chugai Pharmaceutical  
51 Co., Ltd., Asahi Kasei Pharma Co., AstraZeneca K.K., Pfizer Japan Inc., Saibugas Co.,  
52 Ltd., Nippon Steel Co., Hitachi Systems Ltd., Mitsubishi Research Institute Inc., and  
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3 Institute for Building Environment and Energy Conservation.  
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8 **Patient consent for publication**  
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10 Informed consent was provided in advance and all participation was voluntary. The survey  
11 was conducted anonymously, and no personal information was provided to the  
12 researchers.  
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19 **Ethics approval**  
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21 This study was approved by the Institutional Review Board of the Osaka International  
22 Cancer Institute (No. 20084).  
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28 **Provenance and peer review**  
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30 Not commissioned, externally peer reviewed.  
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35 **Data availability statement**  
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37 No additional data are available.  
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Table 1 Demographic characteristics of the participants

	n	(%)
Sex		
Women	6,446	(41.7)
Men	9,008	(58.3)
Age (years)		
15–29	2,326	(15.1)
30–39	3,024	(19.6)
40–49	4,021	(26.0)
50–59	3,301	(21.4)
60–79	2,782	(18.0)
Annual household income (yen)		
Less than 4,000,000	3,817	(24.7)
4,000,000–599,999,999	3,279	(21.2)
6,000,000–899,999,999	2,349	(15.2)
8,000,000 and over	3,522	(22.8)
Unknown	2,487	(16.1)
Employment pattern		
Permanent employee	8,666	(56.0)
Company executive	847	(5.5)
Temporary employee	1,338	(8.7)
Part-time employee	2,870	(18.6)
Self-employed	1,733	(11.2)
Labor type		
Manual work	4,163	(26.9)
Desk work	7,498	(48.6)
Other	3,793	(24.5)
Underlying disease		
Hypertension	2,369	(15.3)
Diabetes	848	(5.5)
Asthma	549	(3.6)
Bronchitis	220	(1.4)
Atopic dermatitis	797	(5.2)
Periodontal disease	1,837	(11.9)
Caries	1,688	(10.9)
Ear disease	173	(1.1)
Angina	212	(1.4)
Myocardial infarction	156	(1.0)
Stroke	131	(0.8)
Chronic obstructive pulmonary disease	128	(0.8)
Cancer	238	(1.5)
Chronic pain	1,557	(10.1)
Depression	583	(3.8)
Other mental health problems	543	(3.5)

Table 2. Disrupted care for employees during the COVID-19 state of emergency and subsequent levels of presenteeism

	Total	WFun score	
		7–20 points (low presenteeism)	21–35 points (high presenteeism)
	N=15,454 (%) (100.0%)	n=12,453 (%) (80.6%)	n=3,001 (%) (19.4%)
My underlying disease got worse (exacerbation of underlying disease)			
N/A (no illness)	10,917 (70.6)	9,002 (72.3)	1,915 (63.8)
No (illness without event)	4,106 (26.6)	3,219 (25.8)	887 (29.6)
Yes (illness with event)	431 (2.8)	232 (1.9)	199 (6.6)
I could not see a doctor for unexpected symptoms or illnesses (disruptions in non-routine clinical settings)			
N/A (no illness)	11,496 (74.4)	9,478 (76.1)	2,018 (67.2)
No (illness without event)	3,235 (20.9)	2,511 (20.2)	724 (24.1)
Yes (illness with event)	723 (4.7)	464 (3.7)	259 (8.6)
I ran out of routine drugs (running out of drugs)			
N/A (no illness)	10,322 (66.8)	8,484 (68.1)	1,838 (61.2)
No (illness without event)	4,572 (29.6)	3,635 (29.2)	937 (31.2)
Yes (illness with event)	560 (3.6)	334 (2.7)	226 (7.5)
I could not see a doctor as scheduled (disruptions in routine clinical settings)			
N/A (no illness)	10,103 (65.4)	8,317 (66.8)	1,786 (59.5)
No (illness without event)	3,651 (23.6)	2,881 (23.1)	770 (25.7)
Yes (illness with event)	1,700 (11.0)	1,255 (10.1)	445 (14.8)

COVID-19: coronavirus disease 2019; WFun: work functioning impairment; N/A: not applicable.

Table 3. Association between disrupted care during the COVID-19 state of emergency and presenteeism

	Univariate			Model 1			Model 2		
	OR	(95% CI)	p value	OR	(95% CI)	p value	OR	(95% CI)	p value
My underlying disease got worse (exacerbation of underlying disease)									
N/A (no illness)	1.00	-	-	1.00	-	-	1.00	-	-
No (illness without event)	1.30	(1.19–1.42)	< 0.001	1.41	(1.27–1.55)	< 0.001	1.21	(1.00–1.47)	0.047
Yes (illness with event)	4.03	(3.32–4.90)	< 0.001	2.84	(2.28–3.53)	< 0.001	2.02	(1.56–2.61)	< 0.001
I could not see a doctor for unexpected symptoms or illnesses (disruptions in non-routine clinical settings)									
N/A (no illness)	1.00	-	-	1.00	-	-	1.00	-	-
No (illness without event)	1.35	(1.23–1.49)	< 0.001	1.40	(1.26–1.55)	< 0.001	1.19	(1.01–1.40)	0.040
Yes (illness with event)	2.62	(2.24–3.08)	< 0.001	2.34	(1.97–2.79)	< 0.001	1.71	(1.40–2.09)	< 0.001
I ran out of routine drugs (running out of drugs)									
N/A (no illness)	1.00	-	-	1.00	-	-	1.00	-	-
No (illness without event)	1.19	(1.09–1.30)	< 0.001	1.28	(1.16–1.41)	< 0.001	0.92	(0.77–1.10)	0.377
Yes (illness with event)	3.12	(2.62–3.73)	< 0.001	2.58	(2.13–3.12)	< 0.001	1.62	(1.29–2.05)	< 0.001
I could not see a doctor as scheduled (disruptions in routine clinical settings)									
N/A (no illness)	1.00	-	-	1.00	-	-	1.00	-	-
No (illness without event)	1.25	(1.13–1.37)	< 0.001	1.34	(1.21–1.49)	< 0.001	1.06	(0.88–1.27)	0.545
Yes (illness with event)	1.65	(1.47–1.86)	< 0.001	1.67	(1.47–1.91)	< 0.001	1.09	(0.92–1.29)	0.346

OR: odds ratio; 95% CI: 95% confidence interval; N/A: not applicable.

Model 1: Adjusted for sex, age, household income, employment pattern, labor type, and underlying disease.

Model 2: Adjusted for sex, age, household income, employment pattern, labor type, underlying disease, exacerbation of underlying disease, disruptions in non-routine clinical settings, running out of drugs, and disruptions in routine clinical settings.

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	8
		(e) Describe any sensitivity analyses	
<b>Results</b>			



Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Disrupted care during the COVID-19 state of emergency and subsequent presenteeism in workers: a nationwide cross-sectional study

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3 **Disrupted care during the COVID-19 state of emergency and subsequent**  
4 **presenteeism in workers: a nationwide cross-sectional study**  
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54 30; Numbers of figures and tables: 1 figure and 4 tables  
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## Abstract

**Objectives:** The coronavirus disease 2019 (COVID-19) pandemic has caused medical care delays and avoidance around the globe. However, little is known about the relationship between disrupted care and productivity loss during the COVID-19 pandemic. We aimed to investigate whether disrupted care during the COVID-19 state of emergency was associated with health status and subsequently with presenteeism, defined as reduced performance at work.

**Methods:** We used data from a nationwide, cross-sectional, Internet-based, self-administered survey. We performed multiple logistic regression analysis on data from 14,545 participants to investigate the associations among variables related to disrupted care, health status, and the Work Functioning Impairment Scale, with a cutoff of 21 points.

**Results:** Participants who experienced exacerbation of underlying disease (adjusted odds ratio [aOR] = 2.84; 95% confidence interval [CI]: 2.28–3.53) or any type of disrupted care were more likely to show low performance at work. Experiencing disruptions in routine and non-routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92 and aOR = 6.29; 95% CI: 4.74–8.34, respectively), and running out of drugs (aOR = 6.13; 95% CI: 4.60–8.18) were strongly associated with exacerbation of underlying disease.

**Conclusions:** Workers who experienced disrupted care were much more likely to show presenteeism, defined as subsequent reduced work performance. Exacerbation of underlying disease is one possible pathway through which disrupted care could affect presenteeism. Our study provides evidence of the importance of early diagnosis and continuous treatment of non-COVID-19 patients to enable them to remain healthy and continue to work during the pandemic.

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2  
3 **Key words:** COVID-19; epidemiology; health resource management; occupational &  
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For peer review only

### Strengths and limitations of this study

- This study provides evidence of the importance of early diagnosis and continuous treatment of non-COVID-19 patients to enable them to remain healthy and continue to work during the pandemic.
- This study revealed an occupational health problem emerging during the COVID-19 pandemic and drew on a large nationwide sample.
- The study used a cross-sectional design, so causal associations among disrupted care, health status, and presenteeism (defined as reduced performance at work) could not be established.
- We did not specify which underlying disease was associated with disrupted care.

## Introduction

Presenteeism, the phenomenon of attending work despite being ill, is closely related to work performance.<sup>1)</sup> It is a global challenge for organizations because it affects workers' productivity and future sickness absence.<sup>2)</sup> According to Johns' theoretical framework,<sup>3)</sup> health status is the basis of presenteeism, and extrinsic pressures and intrinsic motivations strongly influence the choice of whether to go to work when experiencing ill health. Health status is associated with a variety of underlying diseases and conditions, including heart disease, depression, diabetes, and low back pain.<sup>4, 5)</sup> The strongest extrinsic drivers of presenteeism are strict sick leave policies, heavy workloads, and staffing difficulties.<sup>6)</sup> In terms of intrinsic motivational paths, presenteeism is also more likely to occur with low job satisfaction and economic difficulty.<sup>6)</sup> The coronavirus disease 2019 (COVID-19) pandemic may affect presenteeism, including through the health status of workers.<sup>7)</sup>

The COVID-19 pandemic has caused medical care delays and avoidance around the globe.<sup>8-12)</sup> Japan has the lowest morbidity and mortality associated with COVID-19 among all developed countries. A state of emergency was declared on April 7, 2020, for a specific region and then expanded to the whole country from April 16 to May 25, 2020.<sup>13)</sup> All citizens were asked to cancel non-essential appointments and stay at home during this period. In contrast to the situation in many other countries, the Japanese government did not implement a "lockdown" (city blockade), but the non-compulsory state-of-emergency measures had a major impact on human movement.<sup>14)</sup> For example, a nationwide prescription database shows that the volume of otolaryngology prescriptions decreased by 55% and that the number of days of medication per prescription increased by 140%, compared with the same period in 2019.<sup>15)</sup>



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5 Reduced access to care during the state of emergency may have influenced workers'  
6 health status and productivity. A previous study has reported that the COVID-19  
7 pandemic has had an indirect effect on excess deaths from chronic diseases because  
8 of temporary disruptions of care.<sup>16)</sup> On the basis of Johns' theoretical model, we  
9 hypothesized that disrupted care has a negative impact on workers' health status,  
10 resulting in lower productivity.<sup>3)</sup> Many findings on presenteeism behavior during the  
11 COVID-19 pandemic have been reported. Implementing flexible, non-punitive paid  
12 leave and supportive measures as part of a comprehensive approach to preventing  
13 and reducing COVID-19 transmission among employees can have a positive impact  
14 on presenteeism behavior.<sup>7)</sup> Conversely, major shifts in working practices, such as a  
15 change to working from home, and economic difficulties caused by the pandemic have  
16 been found to be strongly associated with presenteeism behavior.<sup>7, 17)</sup> However, little  
17 is known about the relationship between disrupted care and productivity loss during  
18 the COVID-19 pandemic. Therefore, we aimed to investigate whether disrupted care  
19 during the COVID-19 state of emergency was associated with health status and  
20 subsequently increased presenteeism, defined as reduced performance at work.  
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## 44 **Methods**

### 45 **Study design and participants**

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47 This study used data from the Japan COVID-19 and Society Internet Survey (JACSIS).  
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49 This was a nationwide, cross-sectional, Internet-based survey. Self-administered  
50 questionnaires were answered anonymously from August 25 to September 30, 2020.  
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52 The population comprised panelists aged 15 to 79 years who were registered with an  
53 Internet research company (approximately 2.2 million people). Simple random  
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3 sampling was used to select a survey population of 223,389 people, who were invited  
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5 via e-mail to complete the survey. Participation was fully voluntary. After transitioning  
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7 to the linked survey site, participants provided informed consent. We recruited  
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9 participants in clusters by sex, age (in 5-year age bands), and prefecture (47 regions)  
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11 to reflect nationally representative statistics.<sup>18)</sup> We stopped recruitment when the target  
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13 numbers of participants for each sex, age, and prefecture category were reached. A  
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15 total of 28,000 participants responded to the survey (response rate = 12.5%). We  
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17 excluded 10,028 respondents who reported that they were currently unemployed and  
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19 2,518 respondents who gave invalid responses, leaving 15,454 respondents who were  
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21 eligible for analysis (Figure 1).  
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## 28 Outcome

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30 The main study outcome was reduced performance at work (presenteeism), measured  
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32 using the Work Functioning Impairment Scale (WFun).<sup>19)</sup> The WFun, which evaluates  
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34 “the degree to which the ability to function at work is impaired by health problems,”<sup>19)</sup>  
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36 was originally developed in Japan and has shown good correlation with measures of  
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38 different types of presenteeism that have been proposed by scholars in recent years.<sup>19-</sup>  
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21) The WFun includes linear rating scales on the Rasch model<sup>22)</sup> and has appropriate  
measurement properties according to the guideline of consensus-based standards for  
the selection of health measurement instruments.<sup>23)</sup> The WFun contains seven items.  
Each question asks about the respondent’s experience in the last 30 days, meaning  
that we measured presenteeism during August and September 2020 (3 months after  
the COVID-19 state of emergency was eased). For each question, respondents select  
from five options scored from 1 to 5 points. Total WFun scores therefore range from 7  
to 35 points. Higher scores indicate lower performance at work.

## Independent variables

In this study, we hypothesized that disrupted care has a negative impact on workers' health status, resulting in increased presenteeism. Here, the scope of care includes all physical and mental illnesses except for COVID-19 infection. We asked about three types of events related to disrupted care during the COVID-19 state of emergency (April and May 2020) and one event related to the negative impact on self-reported health status. The three types of events related to disrupted care were as follows:

- 1) disruptions in non-routine clinical settings (mostly not medical emergencies but minor illnesses, such as slight fever, wounds, or diarrhea);
- 2) running out of drugs; and
- 3) disruptions in routine clinical settings.

The items related to these three event types were "I could not see a doctor for unscheduled visits," "I ran out of routine drugs", and "I could not see a doctor for scheduled visits." For each item, the response options were *yes*, *no*, and *not applicable*, which we translated as "illness with event," "illness without event," and "no illness."

In addition, the negative impact on health status was assessed by the exacerbation of underlying disease using the following question: "My underlying disease got worse," again with the response options of *yes*, *no*, and *not applicable*.

## Adjusted variables

We collected demographic information about gender, age, annual household income, employment pattern, job type, and underlying disease from questionnaire data. Employment pattern was categorized as permanent employee, company executive,

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3 temporary employee, part-time employee, or self-employed. New employment  
4 patterns are emerging as the labor market changes. Therefore, we asked about both  
5 classic employee patterns (e.g., permanent employment) and new employment  
6 patterns (e.g., temporary employment and self-employment). Job type was categorized  
7 as blue-collar, white-collar, or other jobs. Other jobs mainly comprised “pink-collar” jobs  
8 such as customer service, retail, and nursing care work.<sup>24)</sup> We also asked about 16  
9 types of illnesses, including hypertension, diabetes, and asthma (listed in full in Table  
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### 23 Statistical analysis

24 WFun score was classified into two groups, in line with a previous study<sup>25)</sup>: 7 to 20  
25 points was considered low presenteeism, and 21 to 35 points was considered high  
26 presenteeism. A WFun score of 21 or higher requires consideration of  
27 accommodations and adjustments in the workplace for workers’ illnesses,<sup>25)</sup> and a  
28 score of 25 or higher increases the risk of workers taking sick leave.<sup>26)</sup>  
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40 Univariate and multiple logistic regression analyses were used to investigate the  
41 associations among variables related to health status, those related to disrupted care,  
42 and WFun score. The same statistical techniques were used to evaluate the  
43 association between disrupted care and health status. Participants who chose the “no  
44 illness” option were excluded from part of the analysis. Both analyses were adjusted  
45 for demographic factors (gender, age, household income, employment pattern, job  
46 type, and underlying disease). Goodness of fit was assessed using the Hosmer–  
47 Lemeshow test. All *P*-values were two sided, and *P* < .05 was considered statistically  
48 significant. All analyses were conducted using Stata/SE 16.1 (StataCorp, College  
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## 8 Patient and public involvement

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10 The participants and public were not involved in the design, conduct, reporting, or  
11 dissemination plans of our research.  
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## 17 Results

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19 Table 1 shows the demographic characteristics of the participants. Of 14,545  
20 participants, the majority were men (58.3%), permanent employees (56.0%), and desk  
21 workers (48.6%). The most frequent underlying disease was hypertension (15.3%),  
22 followed by periodontal disease (11.9%), caries (10.9%), and chronic pain (10.1%).  
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31 Table 2 shows the number and proportion of each variable related to disrupted care  
32 and health status by WFun score. One-fifth of the participants (19.4%) scored 21 to 35  
33 points on the WFun scale, indicating relatively low performance at work. In total, 431  
34 participants (2.8%) reported that their underlying disease worsened, 723 (4.7%)  
35 reported that they could not see a doctor for unexpected symptoms or illnesses, and  
36 560 (3.6%) ran out of routine drugs during the state of emergency. A total of 3,651  
37 participants (23.6%) continued to see doctors as scheduled, but 1,700 (11.0%)  
38 reported a disruption of their care.  
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52 Table 3 shows the associations among health status, disrupted care, and WFun score.  
53 In the univariate and multivariate analyses, participants who experienced exacerbation  
54 of underlying disease or any aspect of disrupted care were more likely than others to  
55 show lower performance at work: exacerbation of underlying disease (adjusted odds  
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3 ratio [aOR] = 2.84; 95% confidence interval [CI]: 2.28–3.53), disruptions in non-routine  
4 clinical settings (aOR = 2.34; 95% CI: 1.97–2.79), running out of drugs (aOR = 2.58;  
5 95% CI: 2.13–3.12), and disruptions in routine clinical settings (aOR = 1.67; 95% CI:  
6 1.47–1.91). Work performance was also somewhat associated with having a chronic  
7 disease, even when care was not disrupted (illness without event vs. no illness, all *P*-  
8 values < .001). The Hosmer–Lemeshow test confirmed the goodness of fit of the  
9 adjusted model (*P* > 0.20).  
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21 Table 4 shows the association between the disrupted care variables and health status  
22 for those who had any underlying disease. Each aspect of disrupted care was  
23 associated with an increased likelihood of exacerbation of underlying disease in both  
24 the univariate model and the adjusted model: disruptions in non-routine clinical settings  
25 (aOR = 6.29; 95% CI: 4.74–8.34), running out of drugs (aOR = 6.13; 95% CI: 4.60–  
26 8.18), and disruptions in routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92).  
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## 38 Discussion

39 This study evaluated the association between disrupted care during the COVID-19  
40 state of emergency and health status, as well as the subsequent presenteeism, defined  
41 as a loss of productivity at work. As far as we could establish, our study is among the  
42 first to provide evidence about an occupational health problem emerging from the  
43 COVID-19 pandemic. Among workers, we found that experiencing any of the  
44 measured aspects of disrupted care was strongly associated with exacerbation of  
45 underlying disease, and workers experiencing disrupted care were also much more  
46 likely to subsequently show presenteeism, defined as reduced performance at work.  
47 This suggests that reduced accessibility of care for non-COVID-19 patients during the  
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3 COVID-19 pandemic may have contributed to subsequent reductions in productivity.  
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8 We considered exacerbation of underlying disease as one pathway through which  
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10 disrupted care could affect presenteeism. The current study found that experiencing  
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12 disruptions in routine and non-routine clinical settings and running out of drugs were  
13  
14 strongly associated with exacerbation of underlying disease. Furthermore, workers  
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16 experiencing the exacerbation of underlying disease were much more likely than  
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18 workers without this experience to subsequently show reduced performance at work  
19  
20 (presenteeism). This finding is consistent with a previous study: Gerich showed that  
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22 presenteeism is strongly influenced by the frequency of health events.<sup>27)</sup> Our study  
23  
24 provides insight into the possible harmful impact of reduced accessibility of care on  
25  
26 presenteeism for non-COVID-19 patients. A global survey reported that 24% of  
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28 healthcare providers rated their disease management during the COVID-19 pandemic  
29  
30 as poor or very poor, and the mental health of over 80% of patients worsened during  
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32 the pandemic.<sup>12)</sup> A previous study found significantly higher odds of presenteeism  
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34 among people with psychological complaints, such as mental health problems (aOR =  
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36 20.45), malaise (aOR = 11.91), and sleep problems (aOR = 8.62).<sup>20)</sup> Taken together,  
37  
38 this evidence suggests that interventions to address health complaints resulting from  
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40 poor disease management and mental health problems during the pandemic may be  
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42 important in preventing presenteeism.  
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52 The present study found that care in non-routine clinical settings was associated with  
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54 work performance, especially when this care had been disrupted. This finding is  
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56 consistent with a previous study of emergency department visits during the pandemic,  
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58 which found that medical care delays and avoidance increased the death toll for people  
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3 with non-COVID-19 acute illnesses.<sup>16)</sup> A previous study conducted in the United States  
4 reported that approximately 12% of adults avoided or delayed seeking emergency care  
5 during the pandemic.<sup>11)</sup> In our study, respondents who had experienced disruptions of  
6 non-routine hospital visits for minor illnesses (aOR = 2.34) were more likely than those  
7 who were still able to see a doctor to report reduced performance at work (aOR = 1.40).  
8 One possible reason for this finding is that self-diagnosis and self-triage tend to be  
9 associated with incorrect diagnoses and inappropriate treatment.<sup>28)</sup> These findings  
10 suggest that it is important to receive timely non-routine care during a pandemic,  
11 regardless of the possibility of infection.  
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26 Running out of drugs and disruptions in routine clinical settings were also related to  
27 performance at work. The finding about medication is consistent with a previous study  
28 of depression, which showed that depressed employees often experience long-term  
29 loss of work performance when they run out of drugs.<sup>29)</sup> Our study also demonstrated  
30 that disruptions in routine clinical settings showed a relatively weak association with  
31 reduced performance at work (aOR = 1.67) when compared with running out of drugs  
32 (aOR = 2.58) or disruptions in non-routine clinical settings (aOR = 2.34). Family doctors  
33 tried to offer patients routine care visits during the COVID-19 pandemic whenever they  
34 showed symptoms of exacerbated clinical conditions.<sup>12)</sup> Postponement by family  
35 doctors therefore probably did not have much influence on presenteeism. These  
36 findings suggest that support for continued medication and timely non-routine hospital  
37 visits, rather than routine hospital visits, would help workers to maintain their  
38 productivity at work. Such support might include telemedicine and drug delivery  
39 services.<sup>30)</sup>  
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3 This study has some limitations. Because of the study's cross-sectional design, causal  
4 relations among disrupted care, health status, and presenteeism (defined as reduced  
5 performance at work) could not be established. To cope with this limitation, we asked  
6 about each issue using different time periods: experience of disrupted care during the  
7 COVID-19 state of emergency (April and May 2020) and presenteeism 3 months later  
8 (August and September 2020). However, recall bias may have been an issue.  
9  
10 Furthermore, workers who experienced disrupted care might have been more likely to  
11 remember health problems, which may have caused an overestimation of  
12 presenteeism. In addition, cases of resumed care during this 3-month period may have  
13 attenuated the effects of disrupted care. Another limitation is that we did not specify  
14 which underlying disease was associated with disrupted care. We also did not evaluate  
15 whether underlying diseases developed before or after the outbreak of the COVID-19  
16 pandemic. We adjusted for potential causes in the statistical analysis, but future  
17 studies should consider this issue to clarify the relationship between underlying  
18 diseases and disrupted care. Additionally, the response rate of this study was relatively  
19 low (12.5%). The results should also be interpreted carefully because of the healthy  
20 worker effect. Despite these limitations, this study revealed an occupational health  
21 problem emerging during the COVID-19 pandemic and drew on a large sample of  
22 nationwide data.  
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49 In conclusion, our study showed that workers who experienced disrupted care were  
50 much more likely than others to subsequently show increased presenteeism, defined  
51 as reduced performance at work. Exacerbation of underlying disease is one possible  
52 pathway through which disrupted care could affect presenteeism. Our study provides  
53 evidence of the importance of early diagnosis and continuous treatment of non-COVID-  
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3 19 patients to enable them to remain healthy and continue to work during the pandemic.  
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5 Increasing accessibility of care for patients, for example by offering telemedicine  
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7 appointments and drug delivery, could help workers to maintain their performance at  
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### 14 **Authors' Contributions**

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17 TI conceived the research questions. TT designed the research protocol and collected  
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19 the data. TI conducted the statistical analysis and drafted the initial manuscript with  
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21 YF. KT, AH, MO and NS revised the manuscript. All the authors read and approved  
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23 the final manuscript.  
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39  
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### 47 **Competing Interests**

48  
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56  
57 Institute Inc.; and Institute for Building Environment and Energy Conservation.  
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### **Patient consent for publication**

Informed consent was provided in advance, and all participation was voluntary. The survey was conducted anonymously, and no personal information was provided to the researchers.

### **Ethics approval**

This study was approved by the Institutional Review Board of the Osaka International Cancer Institute (No. 20084).

### **Provenance and peer review**

Not commissioned, externally peer reviewed.

### **Data availability statement**

No additional data are available.

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2020:2020.11.29.20240317.

For peer review only

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3 **Figure legends**  
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5 Figure 1. Flow chart of the study participants.  
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For peer review only



Table 1. Demographic characteristics of the participants

	<i>n</i>	(%)
Gender		
Women	6,446	(41.7)
Men	9,008	(58.3)
Age (years)		
15–29	2,326	(15.1)
30–39	3,024	(19.6)
40–49	4,021	(26.0)
50–59	3,301	(21.4)
60–79	2,782	(18.0)
Annual household income (yen)		
Less than 4,000,000	3,817	(24.7)
4,000,000–599,999,999	3,279	(21.2)
6,000,000–899,999,999	2,349	(15.2)
8,000,000 and higher	3,522	(22.8)
Unknown	2,487	(16.1)
Employment pattern		
Permanent employee	8,666	(56.0)
Company executive	847	(5.5)
Temporary employee	1,338	(8.7)
Part-time employee	2,870	(18.6)
Self-employed	1,733	(11.2)
Labor type		
Manual work	4,163	(26.9)
Desk work	7,498	(48.6)
Other	3,793	(24.5)
Underlying disease		
Hypertension	2,369	(15.3)
Diabetes	848	(5.5)
Asthma	549	(3.6)
Bronchitis	220	(1.4)
Atopic dermatitis	797	(5.2)
Periodontal disease	1,837	(11.9)
Caries	1,688	(10.9)
Ear disease	173	(1.1)
Angina	212	(1.4)
Myocardial infarction	156	(1.0)
Stroke	131	(0.8)
Chronic obstructive pulmonary disease	128	(0.8)
Cancer	238	(1.5)
Chronic pain	1,557	(10.1)
Depression	583	(3.8)
Other mental health problem	543	(3.5)

Table 2. Exacerbation of underlying disease and disrupted care for employees during the COVID-19 state of emergency by WFun score

	Total	WFun score	
		7–20 points (low presenteeism)	21–35 points (high presenteeism)
	<i>N</i> = 15,454 (%) (100.0%)	<i>n</i> = 12,453 (%) (80.6%)	<i>n</i> = 3,001 (%) (19.4%)
My underlying disease got worse (exacerbation of underlying disease)			
N/A (no illness)	10,917 (70.6)	9,002 (72.3)	1,915 (63.8)
No (illness without event)	4,106 (26.6)	3,219 (25.8)	887 (29.6)
Yes (illness with event)	431 (2.8)	232 (1.9)	199 (6.6)
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)			
N/A (no illness)	11,496 (74.4)	9,478 (76.1)	2,018 (67.2)
No (illness without event)	3,235 (20.9)	2,511 (20.2)	724 (24.1)
Yes (illness with event)	723 (4.7)	464 (3.7)	259 (8.6)
I ran out of routine drugs (running out of drugs)			
N/A (no illness)	10,322 (66.8)	8,484 (68.1)	1,838 (61.2)
No (illness without event)	4,572 (29.6)	3,635 (29.2)	937 (31.2)
Yes (illness with event)	560 (3.6)	334 (2.7)	226 (7.5)
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)			
N/A (no illness)	10,103 (65.4)	8,317 (66.8)	1,786 (59.5)
No (illness without event)	3,651 (23.6)	2,881 (23.1)	770 (25.7)
Yes (illness with event)	1,700 (11.0)	1,255 (10.1)	445 (14.8)

COVID-19: coronavirus disease 2019; WFun: Work Functioning Impairment Scale; N/A: not applicable

Table 3. Associations among variables related to disrupted care, variables related to health status, and WFun score

	<i>n</i>	WFun ≥ 21 points %	Univariate			Adjusted*		
			OR	(95% CI)	<i>P</i> -value	OR	(95% CI)	<i>P</i> -value
My underlying disease got worse (exacerbation of underlying disease)								
N/A (no illness)	10,917	17.5	1.00	-	-	1.00	-	-
No (illness without event)	4,106	21.6	1.30	(1.19–1.42)	< .001	1.41	(1.27–1.55)	< .001
Yes (illness with event)	431	46.2	4.03	(3.32–4.90)	< .001	2.84	(2.28–3.53)	< .001
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)								
N/A (no illness)	10,322	17.8	1.00	-	-	1.00	-	-
No (illness without event)	3,235	22.4	1.35	(1.23–1.49)	< .001	1.40	(1.26–1.55)	< .001
Yes (illness with event)	723	35.8	2.62	(2.24–3.08)	< .001	2.34	(1.97–2.79)	< .001
I ran out of routine drugs (running out of drugs)								
N/A (no illness)	10,322	17.8	1.00	-	-	1.00	-	-
No (illness without event)	4,572	20.5	1.19	(1.09–1.30)	< .001	1.28	(1.16–1.41)	< .001
Yes (illness with event)	560	40.4	3.12	(2.62–3.73)	< .001	2.58	(2.13–3.12)	< .001
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)								
N/A (no illness)	10,103	17.7	1.00	-	-	1.00	-	-
No (illness without event)	3,651	21.1	1.25	(1.13–1.37)	< .001	1.34	(1.21–1.49)	< .001
Yes (illness with event)	1,700	26.2	1.65	(1.47–1.86)	< .001	1.67	(1.47–1.91)	< .001

WFun: Work Functioning Impairment Scale; OR: odds ratio; 95% CI: 95% confidence interval; N/A: not applicable

\*Adjusted for gender, age, household income, employment pattern, labor type, and underlying disease

Table 4. Association between disrupted care and exacerbation of underlying disease among those with any underlying illness

	<i>n</i>	Exacerbation of underlying disease %	Univariate			Adjusted*		
			OR	(95% CI)	<i>P</i> -value	OR	(95% CI)	<i>P</i> -value
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)								
No (illness without event)	2,950	5.9	1.00	-	-	1.00	-	-
Yes (illness with event)	415	32.8	7.78	(6.02–10.0)	< .001	6.29	(4.74–8.34)	< .001
I ran out of routine drugs (running out of drugs)								
No (illness without event)	3,156	4.7	1.00	-	-	1.00	-	-
Yes (illness with event)	986	20.9	7.82	(6.04–10.1)	< .001	6.13	(4.60–8.18)	< .001
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)								
No (illness without event)	3,855	5.3	1.00	-	-	1.00	-	-
Yes (illness with event)	390	30.5	5.33	(4.26–6.68)	< .001	4.64	(3.64–5.92)	< .001

OR: odds ratio; 95% CI: 95% confidence interval; N/A: not applicable

\*Adjusted for gender, age, household income, employment pattern, labor type, and underlying disease

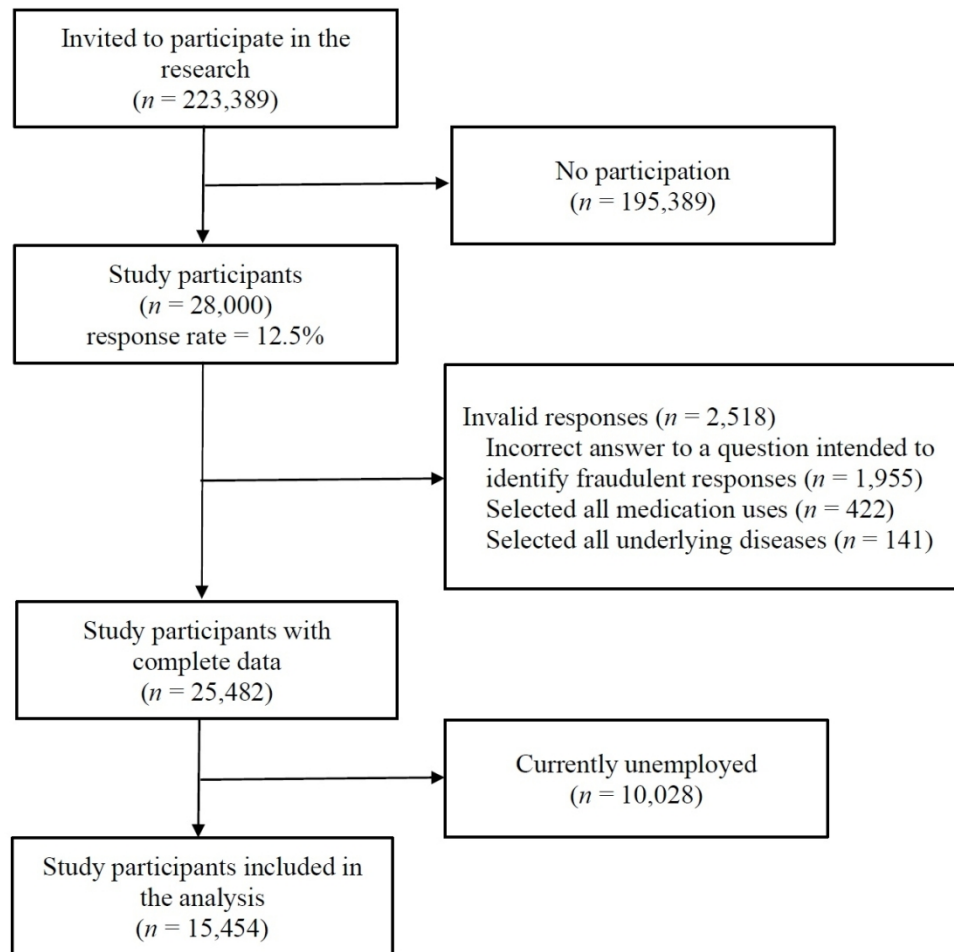


Figure 1. Flow chart of the study participants.

112x110mm (300 x 300 DPI)

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	8
		(e) Describe any sensitivity analyses	
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Disrupted care during the COVID-19 state of emergency and productivity loss attributed to presenteeism in workers: a nationwide cross-sectional study

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<b>Primary Subject Heading</b>:	Occupational and environmental medicine
Secondary Subject Heading:	Occupational and environmental medicine
Keywords:	COVID-19, OCCUPATIONAL & INDUSTRIAL MEDICINE, EPIDEMIOLOGY, Human resource management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 **Disrupted care during the COVID-19 state of emergency and productivity loss**  
4 **attributed to presenteeism in workers: a nationwide cross-sectional study**  
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## Abstract

**Objectives:** The coronavirus disease 2019 (COVID-19) pandemic has caused medical care delays and avoidance around the globe. However, little is known about the relationship between disrupted care and productivity loss attributed to presenteeism during the COVID-19 pandemic. We aimed to investigate whether disrupted care during the COVID-19 state of emergency was associated with health status and productivity loss.

**Methods:** We used data from a nationwide, cross-sectional, Internet-based, self-administered survey. We performed multiple logistic regression analysis on data from 14,545 participants to investigate the associations among variables related to disrupted care, health status, and the Work Functioning Impairment Scale, with a cutoff of 21 points.

**Results:** Participants who experienced exacerbation of underlying disease (adjusted odds ratio [aOR] = 2.84; 95% confidence interval [CI]: 2.28–3.53) or any type of disrupted care were more likely to show low productivity at work. Experiencing disruptions in routine and non-routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92 and aOR = 6.29; 95% CI: 4.74–8.34, respectively), and running out of drugs (aOR = 6.13; 95% CI: 4.60–8.18) were strongly associated with exacerbation of underlying disease.

**Conclusions:** Workers who experienced disrupted care were much more likely to show productivity loss. Exacerbation of underlying disease is one possible pathway through which disrupted care could affect productivity loss attributed to presenteeism. Our study provides evidence of the importance of early diagnosis and continuous treatment of non-COVID-19 patients to enable them to remain healthy and continue to work during the pandemic.

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3 **Key words:** COVID-19; epidemiology; health resource management; occupational &  
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### Strengths and limitations of this study

- This study provides evidence of the importance of early diagnosis and continuous treatment of non-COVID-19 patients to enable them to remain healthy and continue to work during the pandemic.
- This study revealed an occupational health problem emerging during the COVID-19 pandemic and drew on a large nationwide sample.
- The study used a cross-sectional design, so causal associations among disrupted care, health status, and productivity loss could not be established.
- We did not specify which underlying disease was associated with disrupted care.

## Introduction

Presenteeism, the phenomenon of attending work despite being ill, is closely related to work performance.<sup>1)</sup> It is a global challenge for organizations because it affects workers' productivity and future sickness absence.<sup>2)</sup> According to Johns' theoretical framework,<sup>3)</sup> health status is the basis of presenteeism, and extrinsic pressures and intrinsic motivations strongly influence the choice of whether to go to work when experiencing ill health. Health status is associated with a variety of underlying diseases and conditions, including heart disease, depression, diabetes, and low back pain.<sup>4, 5)</sup> The strongest extrinsic drivers of presenteeism are strict sick leave policies, heavy workloads, and staffing difficulties.<sup>6)</sup> In terms of intrinsic motivational paths, presenteeism is also more likely to occur with low job satisfaction and economic difficulty.<sup>6)</sup> The coronavirus disease 2019 (COVID-19) pandemic may affect presenteeism, including through the health status of workers.<sup>7)</sup>

The COVID-19 pandemic has caused medical care delays and avoidance around the globe.<sup>8-12)</sup> Japan has the lowest morbidity and mortality associated with COVID-19 among all developed countries. A state of emergency was declared on April 7, 2020, for a specific region and then expanded to the whole country from April 16 to May 25, 2020.<sup>13)</sup> All citizens were asked to cancel non-essential appointments and stay at home during this period. In contrast to the situation in many other countries, the Japanese government did not implement a "lockdown" (city blockade), but the non-compulsory state-of-emergency measures had a major impact on human movement.<sup>14)</sup> For example, a nationwide prescription database shows that the volume of otolaryngology prescriptions decreased by 55% and that the number of days of medication per prescription increased by 140%, compared with the same period in 2019.<sup>15)</sup>

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5 Reduced access to care during the state of emergency may have influenced workers'  
6 health status and productivity. A previous study has reported that the COVID-19  
7 pandemic has had an indirect effect on excess deaths from chronic diseases because  
8 of temporary disruptions of care.<sup>16)</sup> On the basis of Johns' theoretical model, we  
9 hypothesized that disrupted care has a negative impact on workers' health status,  
10 resulting in lower productivity.<sup>3)</sup> Many findings on presenteeism behavior during the  
11 COVID-19 pandemic have been reported. Implementing flexible, non-punitive paid  
12 leave and supportive measures as part of a comprehensive approach to preventing  
13 and reducing COVID-19 transmission among employees can have a positive impact  
14 on presenteeism behavior.<sup>7)</sup> Conversely, major shifts in working practices, such as a  
15 change to working from home, and economic difficulties caused by the pandemic have  
16 been found to be strongly associated with presenteeism behavior.<sup>7, 17)</sup>

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35 We hypothesized that disrupted care during the state of emergency had a negative  
36 impact on workers' health status and presenteeism, resulting in productivity loss. For  
37 example, workers with back pain are often faced with productivity loss owing to their  
38 pain.<sup>18)</sup> However, if they exhaust their supply of painkillers, the pain may worsen and  
39 further reduce their productivity. Another example is that if depressed workers have  
40 been unable to see a doctor, they may continue to work as their condition worsens  
41 owing to a lack of medical advice about sick leave. However, little is known about the  
42 relationship between disrupted care and productivity loss attributed to presenteeism  
43 during the COVID-19 pandemic. Therefore, we aimed to investigate whether disrupted  
44 care during the COVID-19 state of emergency was associated with health status and  
45 productivity loss.

## Methods

### Study design and participants

This study used data from the Japan COVID-19 and Society Internet Survey (JACSIS). This was a nationwide, cross-sectional, Internet-based survey. Self-administered questionnaires were answered anonymously from August 25 to September 30, 2020. The population comprised panelists aged 15 to 79 years who were registered with an Internet research company (approximately 2.2 million people). Simple random sampling was used to select a survey population of 223,389 people, who were invited via e-mail to complete the survey. Participation was fully voluntary. After transitioning to the linked survey site, participants provided informed consent. We recruited participants in clusters by sex, age (in 5-year age bands), and prefecture (47 regions) to reflect nationally representative statistics.<sup>19)</sup> We stopped recruitment when the target numbers of participants for each sex, age, and prefecture category were reached. A total of 28,000 participants responded to the survey (response rate = 12.5%). We excluded 10,028 respondents who reported that they were currently unemployed and 2,518 respondents who gave unreliable responses, leaving 15,454 respondents who were eligible for analysis (Figure 1).

### Outcome

The main study outcome was productivity loss attributed to presenteeism, measured using the Work Functioning Impairment Scale (WFun).<sup>20)</sup> The WFun, which evaluates “the degree to which the ability to function at work is impaired by health problems,”<sup>20)</sup> was originally developed in Japan and has shown good correlation with measures of different types of presenteeism that have been proposed by scholars in recent years.<sup>20-</sup>



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3 22) The WFun includes linear rating scales on the Rasch model<sup>23)</sup> and has appropriate  
4 measurement properties according to the guideline of consensus-based standards for  
5 the selection of health measurement instruments.<sup>24)</sup> The WFun contains seven items.  
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7 Each question asks about the respondent's experience in the last 30 days, meaning  
8 that we measured work productivity during August and September 2020 (3 months  
9 after the COVID-19 state of emergency was eased). For each question, respondents  
10 select from five options scored from 1 to 5 points. Total WFun scores therefore range  
11 from 7 to 35 points. Higher scores indicate lower performance at work.  
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### 23 Independent variables

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25 In this study, we hypothesized that disrupted care has a negative impact on workers'  
26 health status and presenteeism, resulting in productivity loss. Here, the scope of care  
27 includes all physical and mental illnesses except for COVID-19 infection. We asked  
28 about three types of events related to disrupted care during the COVID-19 state of  
29 emergency (April and May 2020) and one event related to the negative impact on self-  
30 reported health status. The three types of events related to disrupted care were as  
31 follows:  
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- 42 1) disruptions in non-routine clinical settings (mostly not medical emergencies but  
43 minor illnesses, such as slight fever, wounds, or diarrhea);  
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- 46 2) running out of drugs; and  
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- 49 3) disruptions in routine clinical settings.  
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51 The items related to these three event types were "I could not see a doctor for  
52 unscheduled visits," "I ran out of routine drugs", and "I could not see a doctor for  
53 scheduled visits." For each item, the response options were *yes*, *no*, and *not applicable*,  
54 which we translated as "illness with event," "illness without event," and "no illness."  
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5 In addition, the negative impact on health status was assessed by the exacerbation of  
6 underlying disease using the following question: “My underlying disease got worse,”  
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8 again with the response options of *yes*, *no*, and *not applicable*.  
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#### 14 Adjusted variables

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16 We collected demographic information about gender, age, annual household income,  
17 employment pattern, job type, and underlying disease from questionnaire data.  
18 Employment pattern was categorized as permanent employee, company executive,  
19 temporary employee, part-time employee, or self-employed. New employment  
20 patterns are emerging as the labor market changes. Therefore, we asked about both  
21 classic employee patterns (e.g., permanent employment) and new employment  
22 patterns (e.g., temporary employment and self-employment). Job type was categorized  
23 as blue-collar, white-collar, or other jobs. Other jobs mainly comprised “pink-collar” jobs  
24 such as customer service, retail, and nursing care work.<sup>25)</sup> We also asked about 16  
25 types of illnesses, including hypertension, diabetes, and asthma (listed in full in Table  
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#### Statistical analysis

46 WFun score was classified into two groups, in line with a previous study<sup>26)</sup>: 7 to 20  
47 points was considered low productivity at work, and 21 to 35 points was considered  
48 high productivity at work. A WFun score of 21 or higher requires consideration of  
49 accommodations and adjustments in the workplace for workers’ illnesses,<sup>26)</sup> and a  
50 score of 25 or higher increases the risk of workers taking sick leave.<sup>27)</sup>  
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3 Univariate and multiple logistic regression analyses were used to investigate the  
4 associations among variables related to health status, those related to disrupted care,  
5 and WFun score. The same statistical techniques were used to evaluate the  
6 association between disrupted care and health status. Participants who chose the “no  
7 illness” option were excluded from part of the later analysis. Both analyses were  
8 adjusted for demographic factors (gender, age, household income, employment  
9 pattern, job type, and underlying disease). Goodness of fit was assessed using the  
10 Hosmer–Lemeshow test. All *P*-values were two sided, and *P* < .05 was considered  
11 statistically significant. All analyses were conducted using Stata/SE 16.1 (StataCorp,  
12 College Station, TX, USA).  
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#### 28 Patient and public involvement

29 The participants and public were not involved in the design, conduct, reporting, or  
30 dissemination plans of our research.  
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#### 38 Results

39 Table 1 shows the demographic characteristics of the participants. Of 14,545  
40 participants, the majority were men (58.3%), permanent employees (56.0%), and desk  
41 workers (48.6%). The most frequent underlying disease was hypertension (15.3%),  
42 followed by periodontal disease (11.9%), caries (10.9%), and chronic pain (10.1%).  
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51 Table 2 shows the number and proportion of each variable related to disrupted care  
52 and health status by WFun score. One-fifth of the participants (19.4%) scored 21 to 35  
53 points on the WFun scale, indicating relatively low productivity at work. In total, 431  
54 participants (2.8%) reported that their underlying disease worsened, 723 (4.7%)  
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3 reported that they could not see a doctor for unexpected symptoms or illnesses, and  
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5 560 (3.6%) ran out of routine drugs during the state of emergency. A total of 3,651  
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7 participants (23.6%) continued to see doctors as scheduled, but 1,700 (11.0%)  
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9 reported a disruption of their care.  
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14 Table 3 shows the associations among health status, disrupted care, and WFun score.  
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16 In the univariate and multivariate analyses, participants who experienced exacerbation  
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18 of underlying disease or any aspect of disrupted care were more likely than others to  
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20 show lower productivity at work: exacerbation of underlying disease (adjusted odds  
21  
22 ratio [aOR] = 2.84; 95% confidence interval [CI]: 2.28–3.53), disruptions in non-routine  
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24 clinical settings (aOR = 2.34; 95% CI: 1.97–2.79), running out of drugs (aOR = 2.58;  
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26 95% CI: 2.13–3.12), and disruptions in routine clinical settings (aOR = 1.67; 95% CI:  
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28 1.47–1.91). Productivity loss was also somewhat associated with having a chronic  
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30 disease, even when care was not disrupted (illness without event vs. no illness, all *P*-  
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32 values < .001). The Hosmer–Lemeshow test confirmed the goodness of fit of the  
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34 adjusted model (*P* > 0.20).  
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42 Table 4 shows the association between the disrupted care variables and health status  
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44 for those who had any underlying disease. Each aspect of disrupted care was  
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46 associated with an increased likelihood of exacerbation of underlying disease in both  
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48 the univariate model and the adjusted model: disruptions in non-routine clinical settings  
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50 (aOR = 6.29; 95% CI: 4.74–8.34), running out of drugs (aOR = 6.13; 95% CI: 4.60–  
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52 8.18), and disruptions in routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92).  
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## 58 Discussion

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3 This study evaluated the association between disrupted care during the COVID-19  
4 state of emergency and health status, as well as the productivity loss attributed to  
5 presenteeism. As far as we could establish, our study is among the first to provide  
6 evidence about an occupational health problem emerging from the COVID-19  
7 pandemic. Among workers, we found that experiencing any of the measured aspects  
8 of disrupted care was strongly associated with exacerbation of underlying disease, and  
9 workers experiencing disrupted care were also much more likely to show productivity  
10 loss. This suggests that reduced accessibility of care for non-COVID-19 patients during  
11 the COVID-19 pandemic may have contributed to work performance.  
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26 We considered exacerbation of underlying disease as one pathway through which  
27 disrupted care could affect productivity loss. The current study found that experiencing  
28 disruptions in routine and non-routine clinical settings and running out of drugs were  
29 strongly associated with exacerbation of underlying disease. Furthermore, workers  
30 experiencing the exacerbation of underlying disease were much more likely than  
31 workers without this experience to show reduced productivity at work. This finding is  
32 consistent with a previous study: Gerich showed that presenteeism is strongly  
33 influenced by the frequency of health events.<sup>28)</sup> Our study provides insight into the  
34 possible harmful impact of reduced accessibility of care on productivity loss for non-  
35 COVID-19 patients. A global survey reported that 24% of healthcare providers rated  
36 their disease management during the COVID-19 pandemic as poor or very poor, and  
37 the mental health of over 80% of patients worsened during the pandemic.<sup>12)</sup> A previous  
38 study found significantly higher odds of presenteeism among people with psychological  
39 complaints, such as mental health problems (aOR = 20.45), malaise (aOR = 11.91),  
40 and sleep problems (aOR = 8.62).<sup>21)</sup> Taken together, this evidence suggests that  
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3 interventions to address health complaints resulting from poor disease management  
4 and mental health problems during the pandemic may be important in preventing  
5 presenteeism.  
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12 The present study found that care in non-routine clinical settings was associated with  
13 productivity loss, especially when this care had been disrupted. This finding is  
14 consistent with a previous study of emergency department visits during the pandemic,  
15 which found that medical care delays and avoidance increased the death toll for people  
16 with non-COVID-19 acute illnesses.<sup>16)</sup> A previous study conducted in the United States  
17 reported that approximately 12% of adults avoided or delayed seeking emergency care  
18 during the pandemic.<sup>11)</sup> In our study, respondents who had experienced disruptions of  
19 non-routine hospital visits for minor illnesses (aOR = 2.34) were more likely than those  
20 who were still able to see a doctor to report reduced productivity at work (aOR = 1.40).  
21 One possible reason for this finding is that self-diagnosis and self-triage tend to be  
22 associated with incorrect diagnoses and inappropriate treatment.<sup>29)</sup> These findings  
23 suggest that it is important to receive timely non-routine care during a pandemic,  
24 regardless of the possibility of infection.  
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45 Running out of drugs and disruptions in routine clinical settings were also related to  
46 performance at work. The finding about medication is consistent with a previous study  
47 of depression, which showed that depressed employees often experience long-term  
48 loss of work performance when they run out of drugs.<sup>30)</sup> Our study also demonstrated  
49 that disruptions in routine clinical settings showed a relatively weak association with  
50 reduced productivity at work (aOR = 1.67) when compared with running out of drugs  
51 (aOR = 2.58) or disruptions in non-routine clinical settings (aOR = 2.34). Family doctors  
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3 tried to offer patients routine care visits during the COVID-19 pandemic whenever they  
4 showed symptoms of exacerbated clinical conditions.<sup>12)</sup> Postponement by family  
5 doctors therefore probably did not have much influence on presenteeism. These  
6 findings suggest that support for continued medication and timely non-routine hospital  
7 visits, rather than routine hospital visits, would help workers to maintain their  
8 productivity at work. Such support might include telemedicine and drug delivery  
9 services.<sup>31)</sup>

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21 This study has some limitations. Because of the study's cross-sectional design, causal  
22 relations among disrupted care, health status, and productivity loss could not be  
23 established. To cope with this limitation, we asked about each issue using different  
24 time periods: experience of disrupted care during the COVID-19 state of emergency  
25 (April and May 2020) and work performance 3 months later (August and September  
26 2020). However, recall bias may have been an issue. Furthermore, workers who  
27 experienced disrupted care might have been more likely to remember health problems,  
28 which may have caused an overestimation of productivity loss. In addition, cases of  
29 resumed care during this 3-month period may have attenuated the effects of disrupted  
30 care. Another limitation is that we did not specify which underlying disease was  
31 associated with disrupted care. We also did not evaluate whether underlying diseases  
32 developed before or after the outbreak of the COVID-19 pandemic. We adjusted for  
33 potential causes in the statistical analysis, but future studies should consider this issue  
34 to clarify the relationship between underlying diseases and disrupted care. Additionally,  
35 the response rate of this study was relatively low (12.5%). The results should also be  
36 interpreted carefully because of the healthy worker effect. Despite these limitations,  
37 this study revealed an occupational health problem emerging during the COVID-19  
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3 pandemic and drew on a large sample of nationwide data.  
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8 In conclusion, our study showed that workers who experienced disrupted care were  
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10 much more likely than others to show productivity loss. Exacerbation of underlying  
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12 disease is one possible pathway through which disrupted care could affect productivity  
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14 loss attributed to presenteeism. Our study provides evidence of the importance of early  
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16 diagnosis and continuous treatment of non-COVID-19 patients to enable them to  
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18 remain healthy and continue to work during the pandemic. Increasing accessibility of  
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20 care for patients, for example by offering telemedicine appointments and drug delivery,  
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22 could help workers to maintain their performance at work.  
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### 28 **Authors' Contributions**

29  
30 TI conceived the research questions. TT designed the research protocol and collected  
31  
32 the data. TI conducted the statistical analysis and drafted the initial manuscript with  
33  
34 YF. KT, AH, MO and YY revised the manuscript. All the authors read and approved  
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36 the final manuscript.  
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### **Competing Interests**

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### **Patient consent for publication**

Informed consent was provided in advance, and all participation was voluntary. The survey was conducted anonymously, and no personal information was provided to the researchers.

### **Ethics approval**

This study was approved by the Institutional Review Board of the Osaka International Cancer Institute (No. 20084).

### **Provenance and peer review**

Not commissioned, externally peer reviewed.

### **Data availability statement**

No additional data are available.

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3 **Figure legends**  
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5 Figure 1. Flow chart of the study participants.  
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For peer review only

Table 1. Demographic characteristics of the participants

	<i>n</i>	(%)
Gender		
Women	6,446	(41.7)
Men	9,008	(58.3)
Age (years)		
15–29	2,326	(15.1)
30–39	3,024	(19.6)
40–49	4,021	(26.0)
50–59	3,301	(21.4)
60–79	2,782	(18.0)
Annual household income (yen)		
Less than 4,000,000	3,817	(24.7)
4,000,000–599,999,999	3,279	(21.2)
6,000,000–899,999,999	2,349	(15.2)
8,000,000 and higher	3,522	(22.8)
Unknown	2,487	(16.1)
Employment pattern		
Permanent employee	8,666	(56.0)
Company executive	847	(5.5)
Temporary employee	1,338	(8.7)
Part-time employee	2,870	(18.6)
Self-employed	1,733	(11.2)
Labor type		
Manual work	4,163	(26.9)
Desk work	7,498	(48.6)
Other	3,793	(24.5)
Underlying disease		
Hypertension	2,369	(15.3)
Diabetes	848	(5.5)
Asthma	549	(3.6)
Bronchitis	220	(1.4)
Atopic dermatitis	797	(5.2)
Periodontal disease	1,837	(11.9)
Caries	1,688	(10.9)
Ear disease	173	(1.1)
Angina	212	(1.4)
Myocardial infarction	156	(1.0)
Stroke	131	(0.8)
Chronic obstructive pulmonary disease	128	(0.8)
Cancer	238	(1.5)
Chronic pain	1,557	(10.1)
Depression	583	(3.8)
Other mental health problem	543	(3.5)

Table 2. Exacerbation of underlying disease and disrupted care for employees during the COVID-19 state of emergency by WFun score

	Total	WFun score	
		7–20 points (low work productivity)	21–35 points (high work productivity)
	<i>N</i> = 15,454 (%) (100.0%)	<i>n</i> = 12,453 (%) (80.6%)	<i>n</i> = 3,001 (%) (19.4%)
My underlying disease got worse (exacerbation of underlying disease)			
N/A (no illness)	10,917 (70.6)	9,002 (72.3)	1,915 (63.8)
No (illness without event)	4,106 (26.6)	3,219 (25.8)	887 (29.6)
Yes (illness with event)	431 (2.8)	232 (1.9)	199 (6.6)
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)			
N/A (no illness)	11,496 (74.4)	9,478 (76.1)	2,018 (67.2)
No (illness without event)	3,235 (20.9)	2,511 (20.2)	724 (24.1)
Yes (illness with event)	723 (4.7)	464 (3.7)	259 (8.6)
I ran out of routine drugs (running out of drugs)			
N/A (no illness)	10,322 (66.8)	8,484 (68.1)	1,838 (61.2)
No (illness without event)	4,572 (29.6)	3,635 (29.2)	937 (31.2)
Yes (illness with event)	560 (3.6)	334 (2.7)	226 (7.5)
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)			
N/A (no illness)	10,103 (65.4)	8,317 (66.8)	1,786 (59.5)
No (illness without event)	3,651 (23.6)	2,881 (23.1)	770 (25.7)
Yes (illness with event)	1,700 (11.0)	1,255 (10.1)	445 (14.8)

COVID-19: coronavirus disease 2019; WFun: Work Functioning Impairment Scale; N/A: not applicable



Table 3. Associations among variables related to disrupted care, variables related to health status, and WFun score

	<i>n</i>	WFun ≥ 21 points %	Univariate			Adjusted*		
			OR	(95% CI)	<i>P</i> -value	OR	(95% CI)	<i>P</i> -value
My underlying disease got worse (exacerbation of underlying disease)								
N/A (no illness)	10,917	17.5	1.00	-	-	1.00	-	-
No (illness without event)	4,106	21.6	1.30	(1.19–1.42)	< .001	1.41	(1.27–1.55)	< .001
Yes (illness with event)	431	46.2	4.03	(3.32–4.90)	< .001	2.84	(2.28–3.53)	< .001
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)								
N/A (no illness)	10,322	17.8	1.00	-	-	1.00	-	-
No (illness without event)	3,235	22.4	1.35	(1.23–1.49)	< .001	1.40	(1.26–1.55)	< .001
Yes (illness with event)	723	35.8	2.62	(2.24–3.08)	< .001	2.34	(1.97–2.79)	< .001
I ran out of routine drugs (running out of drugs)								
N/A (no illness)	10,322	17.8	1.00	-	-	1.00	-	-
No (illness without event)	4,572	20.5	1.19	(1.09–1.30)	< .001	1.28	(1.16–1.41)	< .001
Yes (illness with event)	560	40.4	3.12	(2.62–3.73)	< .001	2.58	(2.13–3.12)	< .001
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)								
N/A (no illness)	10,103	17.7	1.00	-	-	1.00	-	-
No (illness without event)	3,651	21.1	1.25	(1.13–1.37)	< .001	1.34	(1.21–1.49)	< .001
Yes (illness with event)	1,700	26.2	1.65	(1.47–1.86)	< .001	1.67	(1.47–1.91)	< .001

WFun: Work Functioning Impairment Scale; OR: odds ratio; 95% CI: 95% confidence interval; N/A: not applicable

\*Adjusted for gender, age, household income, employment pattern, labor type, and underlying disease

Table 4. Association between disrupted care and exacerbation of underlying disease among those with any underlying illness

	<i>n</i>	Exacerbation of underlying disease %	Univariate			Adjusted*		
			OR	(95% CI)	<i>P</i> -value	OR	(95% CI)	<i>P</i> -value
I could not see a doctor for unscheduled visits (disruptions in non-routine clinical settings)								
No (illness without event)	2,950	5.9	1.00	-	-	1.00	-	-
Yes (illness with event)	415	32.8	7.78	(6.02–10.0)	< .001	6.29	(4.74–8.34)	< .001
I ran out of routine drugs (running out of drugs)								
No (illness without event)	3,156	4.7	1.00	-	-	1.00	-	-
Yes (illness with event)	986	20.9	7.82	(6.04–10.1)	< .001	6.13	(4.60–8.18)	< .001
I could not see a doctor for scheduled visits (disruptions in routine clinical settings)								
No (illness without event)	3,855	5.3	1.00	-	-	1.00	-	-
Yes (illness with event)	390	30.5	5.33	(4.26–6.68)	< .001	4.64	(3.64–5.92)	< .001

OR: odds ratio; 95% CI: 95% confidence interval; N/A: not applicable

\*Adjusted for gender, age, household income, employment pattern, labor type, and underlying disease

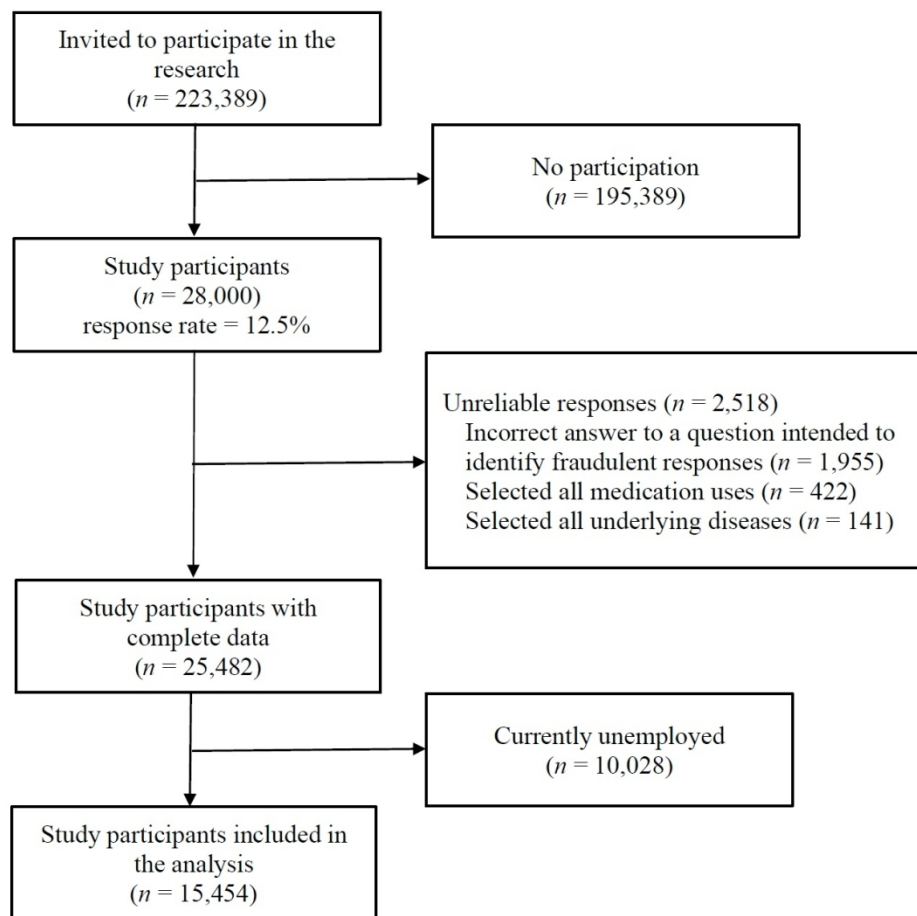


Figure 1. Flow chart of the study participants.

117x112mm (300 x 300 DPI)

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	8
		(e) Describe any sensitivity analyses	
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9
		(b) Report category boundaries when continuous variables were categorized	9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).