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Complete List of Authors:	Ishimaru, Tomohiro; University of Occupational and Environmental Health Japan, Department of Environmental Epidemiology Tsuno, Kanami; Kanagawa University of Human Services, School of Health Innovation Hori, Ai; University of Tsukuba, Department of Global Public Health Okawara, Makoto; University of Occupational and Environmental Health Japan, Department of Environmental Epidemiology Shiota, Naoki; University of Occupational and Environmental Health Japan, Department of Environmental Epidemiology Fujino, Yoshihisa; University of Occupational and Environmental Health Japan, Department of Environmental Epidemiology Tabuchi, Takahiro; Osaka International Cancer Institute, Department of cancer epidemiology
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Disrupted care during the COVID-19 state of emergency and subsequent presenteeism in workers: a nationwide cross-sectional study

Tomohiro Ishimaru[1], Kanami Tsuno[2], Ai Hori[3], Makoto Okawara[1], Naoki Shiota[1], Yoshihisa Fujino[1], Takahiro Tabuchi[4]

[1] Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu 807-8555, Japan

[2] School of Health Innovation, Kanagawa University of Human Services, Kawasaki 210-0821, Japan

[3] Department of Global Public Health, University of Tsukuba, Ibaraki 305-8577, Japan

[4] Cancer Control Center, Osaka International Cancer Institute, Osaka 541-8567, Japan

Corresponding author: Tomohiro Ishimaru, MD, MPH, PhD

Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, 1-1 Iseigaoka, Yahata-nishi-ku, Kitakyushu, Fukuoka 807-8555, Japan.

Tel: +81-93-603-1611, Fax: +81-93-601-7324, E-mail: ishimaru@med.uoeh-u.ac.jp

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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.

Conclusions: Disrupted care was strongly associated with presenteeism. Because of the gap between the results of adjusted models, exacerbation of underlying disease was considered to be one pathway by which disrupted care can affect presenteeism. Timely care for acute illness and support for continued medication for chronic diseases during health emergencies would be helpful to reduce subsequent presenteeism among those with chronic illnesses.

Key words: COVID-19; epidemiology; health resource management; occupational & industrial health

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.

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.[1)] 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”.[2)] 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).[3)] Presenteeism is also associated with an increased risk of occupational injuries because of human error.[4, 5)] There is extensive evidence that various chronic diseases are associated with presenteeism, including heart disease, depression, diabetes, and low back pain.[6, 7)] 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.[8-12)] 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.[13)] 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.[14)] 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.[15)]

Reduced access to care during the state of emergency may have influenced workers' subsequent health and therefore presenteeism. A previous study reported that the COVID-19 pandemic has had an indirect effect on excess deaths from chronic diseases because of the temporary disruption to care.[16] Another study revealed that job insecurity related to the pandemic was strongly associated with attending work despite being ill.[17] Many underlying diseases are associated with presenteeism,[6, 7] 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 in workers. 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 a pandemic.

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 between 25th August and 30th September 2020. The accessible population was 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 who were invited to complete the survey via e-mail. We recruited participants in clusters by sex, age and prefecture based on national representative statistics,[18] and ceased the recruitment after a sample of 28,000 had been collected (response rate 12.5%). We excluded 10,028 respondents who answered that they were currently unemployed and 2,518 respondents who gave

invalid responses, leaving 15,454 respondents eligible for analysis.

Outcome

The main study outcome was presenteeism, measured using the Work Functioning Impairment Scale (WFun).[19] This was originally developed in Japan and showed good correlation with other presenteeism instruments.[19-21] It has two main points: linear rating scales on the Rasch model[22] and proper measurement properties according to the guideline of consensus-based standards for the selection of health measurement instruments.[23] The WFun contains seven items. Each question asks about 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 selected from five options, scoring 1 to 5 points. The total score therefore ranged from 7 to 35 points. Higher scores indicate worse presenteeism.

Independent variables

We asked about four events related to disrupted care during the COVID-19 state of emergency (April to May 2020):

1) exacerbation of underlying disease;

2) disruptions in non-routine clinical settings;

3) running out of drugs; and

4) disruptions in routine clinical settings.

The items related to each variable were: "My underlying disease got worse", "I could not see a doctor for unexpected symptoms or illnesses", "I ran out of routine drugs", and "I could not see a doctor as scheduled". Responses were chosen from the three options:

"Yes", "No" and "Not applicable", which we translated as "illness with event", "illness without event", and "no illness".

Adjusted variables

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

Statistical analysis

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

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

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

Discussion

This study evaluated association between disrupted care during the COVID-19 state of emergency and subsequent presenteeism. As far as we can establish, it is one of the first studies to provide evidence about an occupational health problem emerging from the COVID-19 pandemic. In model 1, we found that workers who experienced any variables related to disrupted care were much more likely to show subsequent presenteeism. Presenteeism was associated with chronic illnesses even among workers whose care continued. This suggests that early diagnosis and continuous treatment for ill health are important for reducing presenteeism. It is possible that reduced accessibility of care for non-COVID-19 patients during the COVID-19 pandemic may have contributed to reduced productivity later.

We considered that exacerbation of underlying disease was one pathway by which disrupted care could affect presenteeism. The gap between the results of our models 1 and 2, especially on disruptions in routine clinical settings, could be because exacerbation of underlying disease affected the results of other variables in model 2. A global survey reported that 24% of healthcare providers rated their disease management during the COVID-19 pandemic as poor or very poor, and the mental health of over 80% of patients

got worse during the period.[12] A previous study found that people with psychological complaints were at significantly higher odds of presenteeism, for example mental health problems (aOR = 20.45), malaise (aOR = 11.91) and sleeping problems (aOR = 8.62).[20] This evidence suggests that presenteeism may have been caused by health complaints resulting from poor disease management and mental health problems during the pandemic.

This study identified that unexpected symptoms or illnesses during the pandemic were associated with presenteeism, especially where care had been disrupted. The finding is consistent with a previous study of emergency department visits during the pandemic: delay and avoidance of medical care increased the death toll for people with non-COVID-19 acute illnesses.[16] Approximately 12% of adults avoided or delayed seeking emergency care during the pandemic in the United States.[11] In our study, participants who had experienced disruptions in non-routine clinical settings were relatively more likely to show later presenteeism than those who had seen a doctor (aOR = 1.71 vs 1.19 in model 2). One possible reason is that self-diagnosis and triage tend to be associated with incorrect diagnosis and inappropriate treatment.[26] These findings suggest it is important to receive timely care for acute illness regardless of possible infection during a pandemic.

Running out of drugs was also related to presenteeism, but disruptions in routine clinical settings were not. The finding about medication is consistent with a previous study of depression, which showed that depressed employees often experience long-term loss of work performance when they run out of drugs.[27] Our study also demonstrated that disruptions in routine clinical settings showed no association in model 2, which adjusted

for exacerbation of underlying disease and relevant factors. Family doctors tried to extend patients' routine care visits during the COVID-19 pandemic whenever patients showed exacerbated clinical conditions.[12] Postponement by family doctors therefore probably did not influence presenteeism. These findings suggest that support for continued medication and timely emergency care during health emergencies, rather than routine hospital visits, would help workers to avoid subsequent presenteeism. This might include telemedicine and drug delivery services.[28]

This study had some limitations. It used a cross-sectional design, so causality between disrupted care and presenteeism cannot be established. To cope with this limitation, we asked about each issue using different time periods: experience of disrupted care during the COVID-19 state of emergency (April to May 2020) and presenteeism 3 months later (August and September 2020). However, recall bias may have been an issue. Workers who experienced disrupted care might be more likely to remember health problems, which may cause an overestimation of presenteeism. Another limitation is that we did not specify which underlying disease was associated with disrupted care. We adjusted for potential causes in the statistical analysis, but future studies should consider this issue to clarify the relationship between underlying diseases and disrupted care. Despite these limitations, this study revealed an occupational health problem emerging during the pandemic, and drew on a large sample of nationwide data.

In conclusion, our study showed that workers who experienced disrupted care were much more likely to show subsequent presenteeism. This finding suggests that disrupted care may influence workers' subsequent performance. Exacerbation of underlying disease is

one possible pathway by which disrupted care could affect presenteeism. Timely care for acute illness and support for continued medication for underlying diseases would be helpful to ensure that workers can continue to operate even during health crises. In future similar situations, increasing accessibility of care for patients, such as telemedicine and drug delivery service, could help.

Contributors

TI conceived the research questions. TT designed the research protocol and collected data. TI conducted the statistical analysis and drafted the initial manuscript with YF. KT and AH revised the manuscript. All the authors read and approved the final manuscript.

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Conflict of Interest

YF has received research grants and/or personal fees from NTT DATA MSE Corp., The LOFT Co., Ltd., Sompo Health Support Inc., Asahi Shimbun Co., Chugai Pharmaceutical Co., Ltd., Asahi Kasei Pharma Co., AstraZeneca K.K., Pfizer Japan Inc., Saibugas Co., Ltd., Nippon Steel Co., Hitachi Systems Ltd., Mitsubishi Research Institute Inc., and

Institute for Building Environment and Energy Conservation.

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.

ORCID iDs

Tomohiro Ishimaru https://orcid.org/0000-0002-9334-1423

Kanami Tsuno https://orcid.org/0000-0001-9399-6596

Ai Hori https://orcid.org/0000-0002-0191-5996

Makoto Okawara https://orcid.org/0000-0002-2777-743X

Yoshihisa Fujino https://orcid.org/0000-0002-9126-206X

Takahiro Tabuchi https://orcid.org/0000-0002-1050-3125

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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 #
Title and abstract	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
Introduction			
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
Methods			
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	
Results			

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
Discussion			
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
Other information			
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.

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

Tomohiro Ishimaru[1], Kanami Tsuno[2], Ai Hori[3], Makoto Okawara[1], Naoki Shiota[1], Yoshihisa Fujino[1], Takahiro Tabuchi[4]

[1]Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu 807-8555, Japan

[2]School of Health Innovation, Kanagawa University of Human Services, Kawasaki 210-0821, Japan

[3]Department of Global Public Health, University of Tsukuba, Ibaraki 305-8577, Japan

[4]Cancer Control Center, Osaka International Cancer Institute, Osaka 541-8567, Japan

Corresponding author: Tomohiro Ishimaru, MD, MPH, PhD

Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, 1-1 Iseigaoka, Yahata-nishi-ku, Kitakyushu, Fukuoka 807-8555, Japan

Tel: +81-93-603-1611, Fax: +81-93-601-7324, E-mail: ishimaru@med.uoeh-u.ac.jp

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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.

Key words: COVID-19; epidemiology; health resource management; occupational & industrial health

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.[1)] It is a global challenge for organizations because it affects workers' productivity and future sickness absence.[2)] According to Johns' theoretical framework,[3)] 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.[4, 5)] The strongest extrinsic drivers of presenteeism are strict sick leave policies, heavy workloads, and staffing difficulties.[6)] In terms of intrinsic motivational paths, presenteeism is also more likely to occur with low job satisfaction and economic difficulty.[6)] The coronavirus disease 2019 (COVID-19) pandemic may affect presenteeism, including through the health status of workers.[7)]

The COVID-19 pandemic has caused medical care delays and avoidance around the globe.[8-12)] 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.[13)] 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.[14)] 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.[15)]

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

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.[18] 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 invalid responses, leaving 15,454 respondents who were eligible for analysis (Figure 1).

Outcome

The main study outcome was reduced performance at work (presenteeism), measured using the Work Functioning Impairment Scale (WFun).[19] The WFun, which evaluates "the degree to which the ability to function at work is impaired by health problems,"[19] 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.[19-21] The WFun includes linear rating scales on the Rasch model[22] and has appropriate measurement properties according to the guideline of consensus-based standards for the selection of health measurement instruments.[23] 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,

temporary employee, part-time employee, or self-employed. New employment patterns are emerging as the labor market changes. Therefore, we asked about both classic employee patterns (e.g., permanent employment) and new employment patterns (e.g., temporary employment and self-employment). Job type was categorized as blue-collar, white-collar, or other jobs. Other jobs mainly comprised "pink-collar" jobs such as customer service, retail, and nursing care work.[24] We also asked about 16 types of illnesses, including hypertension, diabetes, and asthma (listed in full in Table 1).

Statistical analysis

WFun score was classified into two groups, in line with a previous study[25]: 7 to 20 points was considered low presenteeism, and 21 to 35 points was considered high presenteeism. A WFun score of 21 or higher requires consideration of accommodations and adjustments in the workplace for workers' illnesses,[25] and a score of 25 or higher increases the risk of workers taking sick leave.[26]

Univariate and multiple logistic regression analyses were used to investigate the associations among variables related to health status, those related to disrupted care, and WFun score. The same statistical techniques were used to evaluate the association between disrupted care and health status. Participants who chose the "no illness" option were excluded from part of the analysis. Both analyses were adjusted for demographic factors (gender, age, household income, employment pattern, job type, and underlying disease). Goodness of fit was assessed using the Hosmer–Lemeshow test. All *P*-values were two sided, and $P < .05$ was considered statistically significant. All analyses were conducted using Stata/SE 16.1 (StataCorp, College

Station, TX, USA).

Patient and public involvement

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

Results

Table 1 shows the 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 health status by WFun score. One-fifth of the participants (19.4%) scored 21 to 35 points on the WFun scale, indicating relatively low performance at work. In total, 431 participants (2.8%) reported that their underlying disease worsened, 723 (4.7%) reported 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 doctors as scheduled, but 1,700 (11.0%) reported a disruption of their care.

Table 3 shows the associations among health status, disrupted care, and WFun score. In the univariate and multivariate analyses, participants who experienced exacerbation of underlying disease or any aspect of disrupted care were more likely than others to show lower performance at work: exacerbation of underlying disease (adjusted odds

ratio [aOR] = 2.84; 95% *c*onfidence interval [CI]: 2.28–3.53), disruptions in non-routine clinical settings (aOR = 2.34; 95% CI: 1.97–2.79), running out of drugs (aOR = 2.58; 95% CI: 2.13–3.12), and disruptions in routine clinical settings (aOR = 1.67; 95% CI: 1.47–1.91). Work performance was also somewhat associated with having a chronic disease, even when care was not disrupted (illness without event vs. no illness, all *P*-values < .001). The Hosmer–Lemeshow test confirmed the goodness of fit of the adjusted model ($P > 0.20$).

Table 4 shows the association between the disrupted care variables and health status for those who had any underlying disease. Each aspect of disrupted care was associated with an increased likelihood of exacerbation of underlying disease in both the univariate model and the adjusted model: disruptions in non-routine clinical settings (aOR = 6.29; 95% CI: 4.74–8.34), running out of drugs (aOR = 6.13; 95% CI: 4.60–8.18), and disruptions in routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92).

Discussion

This study evaluated the association between disrupted care during the COVID-19 state of emergency and health status, as well as the subsequent presenteeism, defined as a loss of productivity at work. As far as we could establish, our study is among the first to provide evidence about an occupational health problem emerging from the COVID-19 pandemic. Among workers, we found that experiencing any of the measured aspects of disrupted care was strongly associated with exacerbation of underlying disease, and workers experiencing disrupted care were also much more likely to subsequently show presenteeism, defined as reduced performance at work. This suggests that reduced accessibility of care for non-COVID-19 patients during the

COVID-19 pandemic may have contributed to subsequent reductions in productivity.

We considered exacerbation of underlying disease as one pathway through which disrupted care could affect presenteeism. The current study found that experiencing disruptions in routine and non-routine clinical settings and running out of drugs were strongly associated with exacerbation of underlying disease. Furthermore, workers experiencing the exacerbation of underlying disease were much more likely than workers without this experience to subsequently show reduced performance at work (presenteeism). This finding is consistent with a previous study: Gerich showed that presenteeism is strongly influenced by the frequency of health events.[27)] Our study provides insight into the possible harmful impact of reduced accessibility of care on presenteeism for non-COVID-19 patients. A global survey reported that 24% of healthcare providers rated their disease management during the COVID-19 pandemic as poor or very poor, and the mental health of over 80% of patients worsened during the pandemic.[12)] A previous study found significantly higher odds of presenteeism among people with psychological complaints, such as mental health problems (aOR = 20.45), malaise (aOR = 11.91), and sleep problems (aOR = 8.62).[20)] Taken together, this evidence suggests that interventions to address health complaints resulting from poor disease management and mental health problems during the pandemic may be important in preventing presenteeism.

The present study found that care in non-routine clinical settings was associated with work performance, especially when this care had been disrupted. This finding is consistent with a previous study of emergency department visits during the pandemic, which found that medical care delays and avoidance increased the death toll for people

with non-COVID-19 acute illnesses.[16] A previous study conducted in the United States reported that approximately 12% of adults avoided or delayed seeking emergency care during the pandemic.[11] In our study, respondents who had experienced disruptions of non-routine hospital visits for minor illnesses (aOR = 2.34) were more likely than those who were still able to see a doctor to report reduced performance at work (aOR = 1.40). One possible reason for this finding is that self-diagnosis and self-triage tend to be associated with incorrect diagnoses and inappropriate treatment.[28] These findings suggest that it is important to receive timely non-routine care during a pandemic, regardless of the possibility of infection.

Running out of drugs and disruptions in routine clinical settings were also related to performance at work. The finding about medication is consistent with a previous study of depression, which showed that depressed employees often experience long-term loss of work performance when they run out of drugs.[29] Our study also demonstrated that disruptions in routine clinical settings showed a relatively weak association with reduced performance at work (aOR = 1.67) when compared with running out of drugs (aOR = 2.58) or disruptions in non-routine clinical settings (aOR = 2.34). Family doctors tried to offer patients routine care visits during the COVID-19 pandemic whenever they showed symptoms of exacerbated clinical conditions.[12] Postponement by family doctors therefore probably did not have much influence on presenteeism. These findings suggest that support for continued medication and timely non-routine hospital visits, rather than routine hospital visits, would help workers to maintain their productivity at work. Such support might include telemedicine and drug delivery services.[30]

This study has some limitations. Because of the study's cross-sectional design, causal relations among disrupted care, health status, and presenteeism (defined as reduced performance at work) could not be established. To cope with this limitation, we asked about each issue using different time periods: experience of disrupted care during the COVID-19 state of emergency (April and May 2020) and presenteeism 3 months later (August and September 2020). However, recall bias may have been an issue. Furthermore, workers who experienced disrupted care might have been more likely to remember health problems, which may have caused an overestimation of presenteeism. In addition, cases of resumed care during this 3-month period may have attenuated the effects of disrupted care. Another limitation is that we did not specify which underlying disease was associated with disrupted care. We also did not evaluate whether underlying diseases developed before or after the outbreak of the COVID-19 pandemic. We adjusted for potential causes in the statistical analysis, but future studies should consider this issue to clarify the relationship between underlying diseases and disrupted care. Additionally, the response rate of this study was relatively low (12.5%). The results should also be interpreted carefully because of the healthy worker effect. Despite these limitations, this study revealed an occupational health problem emerging during the COVID-19 pandemic and drew on a large sample of nationwide data.

In conclusion, our study showed that workers who experienced disrupted care were much more likely than others to subsequently show increased presenteeism, defined as reduced performance at work. 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. Increasing accessibility of care for patients, for example by offering telemedicine appointments and drug delivery, could help workers to maintain their performance at work.

Authors' Contributions

TI conceived the research questions. TT designed the research protocol and collected the data. TI conducted the statistical analysis and drafted the initial manuscript with YF. KT, AH, MO and NS revised the manuscript. All the authors read and approved the final manuscript.

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Competing Interests

YF has received research grants and/or personal fees from NTT DATA MSE Corp.; The LOFT Co., Ltd.; Sompo Health Support Inc.; Asahi Shimbun Co.; Chugai Pharmaceutical Co., Ltd.; Asahi Kasei Pharma Co.; AstraZeneca K.K.; Pfizer Japan Inc.; Saibugas Co., Ltd.; Nippon Steel Co.; Hitachi Systems Ltd.; Mitsubishi Research Institute Inc.; and Institute for Building Environment and Energy Conservation.

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.

ORCID iDs

Tomohiro Ishimaru https://orcid.org/0000-0002-9334-1423

Kanami Tsuno https://orcid.org/0000-0001-9399-6596

Ai Hori https://orcid.org/0000-0002-0191-5996

Makoto Okawara https://orcid.org/0000-0002-2777-743X

Yoshihisa Fujino https://orcid.org/0000-0002-9126-206X

Takahiro Tabuchi https://orcid.org/0000-0002-1050-3125

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Figure legends

Figure 1. Flow chart of the study participants.

Table 1. Demographic characteristics of the participants

	n	(%)
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)	
	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 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

	n	WFun ≥ 21 points %	Univariate OR	(95% CI)	*P*-value	Adjusted* OR	(95% CI)	*P*-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

	n	Exacerbation of underlying disease	Univariate			Adjusted*		
		%	OR	(95% CI)	*P*-value	OR	(95% CI)	*P*-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

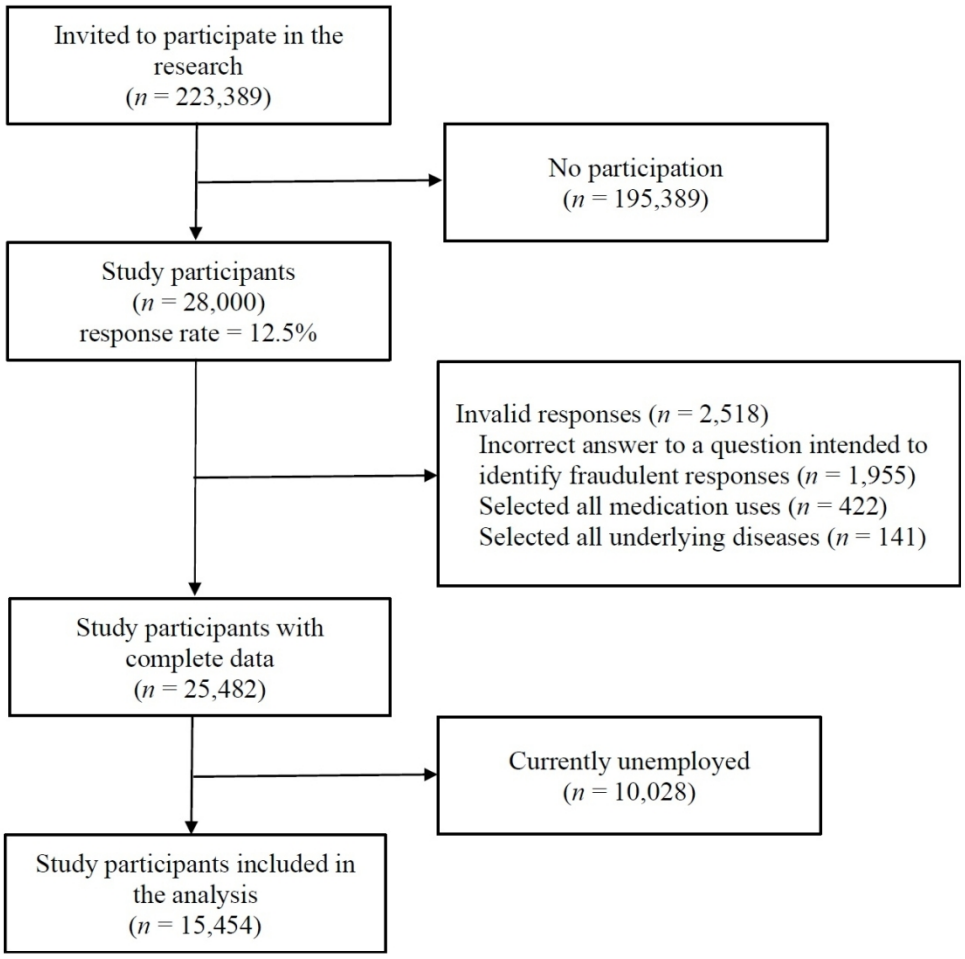

Figure 1. Flow chart of the study participants.

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 #
Title and abstract	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
Introduction			
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
Methods			
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	
Results			

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
Discussion			
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
Other information			
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.

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

Tomohiro Ishimaru[1], Kanami Tsuno[2], Ai Hori[3], Makoto Okawara[1], Yoshino Yasuda[1], Yoshihisa Fujino[1], Takahiro Tabuchi[4]

[1]Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu 807-8555, Japan

[2]School of Health Innovation, Kanagawa University of Human Services, Kawasaki 210-0821, Japan

[3]Department of Global Public Health, University of Tsukuba, Ibaraki 305-8577, Japan

[4]Cancer Control Center, Osaka International Cancer Institute, Osaka 541-8567, Japan

Corresponding author: Tomohiro Ishimaru, MD, MPH, PhD

Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, 1-1 Iseigaoka, Yahata-nishi-ku, Kitakyushu, Fukuoka 807-8555, Japan

Tel: +81-93-603-1611, Fax: +81-93-601-7324, E-mail: ishimaru@med.uoeh-u.ac.jp

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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.

Key words: COVID-19; epidemiology; health resource management; occupational & industrial health

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.[1)] It is a global challenge for organizations because it affects workers' productivity and future sickness absence.[2)] According to Johns' theoretical framework,[3)] 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.[4, 5)] The strongest extrinsic drivers of presenteeism are strict sick leave policies, heavy workloads, and staffing difficulties.[6)] In terms of intrinsic motivational paths, presenteeism is also more likely to occur with low job satisfaction and economic difficulty.[6)] The coronavirus disease 2019 (COVID-19) pandemic may affect presenteeism, including through the health status of workers.[7)]

The COVID-19 pandemic has caused medical care delays and avoidance around the globe.[8-12)] 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.[13)] 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.[14)] 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.[15)]

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

We hypothesized that disrupted care during the state of emergency had a negative impact on workers' health status and presenteeism, resulting in productivity loss. For example, workers with back pain are often faced with productivity loss owing to their pain.[18)] However, if they exhaust their supply of painkillers, the pain may worsen and further reduce their productivity. Another example is that if depressed workers have been unable to see a doctor, they may continue to work as their condition worsens owing to a lack of medical advice about sick leave. However, little is known about the relationship between disrupted care and productivity loss attributed to presenteeism during the COVID-19 pandemic. Therefore, we aimed to investigate whether disrupted care during the COVID-19 state of emergency was associated with health status and 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.[19] 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).[20] The WFun, which evaluates "the degree to which the ability to function at work is impaired by health problems,"[20] 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.[20-

[22] The WFun includes linear rating scales on the Rasch model[23] and has appropriate measurement properties according to the guideline of consensus-based standards for the selection of health measurement instruments.[24] The WFun contains seven items. Each question asks about the respondent's experience in the last 30 days, meaning that we measured work productivity 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 and presenteeism, resulting in productivity loss. 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, temporary employee, part-time employee, or self-employed. New employment patterns are emerging as the labor market changes. Therefore, we asked about both classic employee patterns (e.g., permanent employment) and new employment patterns (e.g., temporary employment and self-employment). Job type was categorized as blue-collar, white-collar, or other jobs. Other jobs mainly comprised “pink-collar” jobs such as customer service, retail, and nursing care work.[25] We also asked about 16 types of illnesses, including hypertension, diabetes, and asthma (listed in full in Table 1).

Statistical analysis

WFun score was classified into two groups, in line with a previous study[26]: 7 to 20 points was considered low productivity at work, and 21 to 35 points was considered high productivity at work. A WFun score of 21 or higher requires consideration of accommodations and adjustments in the workplace for workers’ illnesses,[26] and a score of 25 or higher increases the risk of workers taking sick leave.[27]

Univariate and multiple logistic regression analyses were used to investigate the associations among variables related to health status, those related to disrupted care, and WFun score. The same statistical techniques were used to evaluate the association between disrupted care and health status. Participants who chose the “no illness” option were excluded from part of the later analysis. Both analyses were adjusted for demographic factors (gender, age, household income, employment pattern, job type, and underlying disease). Goodness of fit was assessed using the Hosmer–Lemeshow test. All *P*-values were two sided, and $P < .05$ was considered statistically significant. All analyses were conducted using Stata/SE 16.1 (StataCorp, College Station, TX, USA).

Patient and public involvement

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

Results

Table 1 shows the 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 health status by WFun score. One-fifth of the participants (19.4%) scored 21 to 35 points on the WFun scale, indicating relatively low productivity at work. In total, 431 participants (2.8%) reported that their underlying disease worsened, 723 (4.7%)

reported 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 doctors as scheduled, but 1,700 (11.0%) reported a disruption of their care.

Table 3 shows the associations among health status, disrupted care, and WFun score. In the univariate and multivariate analyses, participants who experienced exacerbation of underlying disease or any aspect of disrupted care were more likely than others to show lower productivity at work: exacerbation of underlying disease (adjusted odds ratio [aOR] = 2.84; 95% confidence interval [CI]: 2.28–3.53), disruptions in non-routine clinical settings (aOR = 2.34; 95% CI: 1.97–2.79), running out of drugs (aOR = 2.58; 95% CI: 2.13–3.12), and disruptions in routine clinical settings (aOR = 1.67; 95% CI: 1.47–1.91). Productivity loss was also somewhat associated with having a chronic disease, even when care was not disrupted (illness without event vs. no illness, all *P*-values < .001). The Hosmer–Lemeshow test confirmed the goodness of fit of the adjusted model ($P > 0.20$).

Table 4 shows the association between the disrupted care variables and health status for those who had any underlying disease. Each aspect of disrupted care was associated with an increased likelihood of exacerbation of underlying disease in both the univariate model and the adjusted model: disruptions in non-routine clinical settings (aOR = 6.29; 95% CI: 4.74–8.34), running out of drugs (aOR = 6.13; 95% CI: 4.60–8.18), and disruptions in routine clinical settings (aOR = 4.64; 95% CI: 3.64–5.92).

Discussion

This study evaluated the association between disrupted care during the COVID-19 state of emergency and health status, as well as the productivity loss attributed to presenteeism. As far as we could establish, our study is among the first to provide evidence about an occupational health problem emerging from the COVID-19 pandemic. Among workers, we found that experiencing any of the measured aspects of disrupted care was strongly associated with exacerbation of underlying disease, and workers experiencing disrupted care were also much more likely to show productivity loss. This suggests that reduced accessibility of care for non-COVID-19 patients during the COVID-19 pandemic may have contributed to work performance.

We considered exacerbation of underlying disease as one pathway through which disrupted care could affect productivity loss. The current study found that experiencing disruptions in routine and non-routine clinical settings and running out of drugs were strongly associated with exacerbation of underlying disease. Furthermore, workers experiencing the exacerbation of underlying disease were much more likely than workers without this experience to show reduced productivity at work. This finding is consistent with a previous study: Gerich showed that presenteeism is strongly influenced by the frequency of health events.[28] Our study provides insight into the possible harmful impact of reduced accessibility of care on productivity loss for non-COVID-19 patients. A global survey reported that 24% of healthcare providers rated their disease management during the COVID-19 pandemic as poor or very poor, and the mental health of over 80% of patients worsened during the pandemic.[12] A previous study found significantly higher odds of presenteeism among people with psychological complaints, such as mental health problems (aOR = 20.45), malaise (aOR = 11.91), and sleep problems (aOR = 8.62).[21] Taken together, this evidence suggests that

interventions to address health complaints resulting from poor disease management and mental health problems during the pandemic may be important in preventing presenteeism.

The present study found that care in non-routine clinical settings was associated with productivity loss, especially when this care had been disrupted. This finding is consistent with a previous study of emergency department visits during the pandemic, which found that medical care delays and avoidance increased the death toll for people with non-COVID-19 acute illnesses.[16] A previous study conducted in the United States reported that approximately 12% of adults avoided or delayed seeking emergency care during the pandemic.[11] In our study, respondents who had experienced disruptions of non-routine hospital visits for minor illnesses (aOR = 2.34) were more likely than those who were still able to see a doctor to report reduced productivity at work (aOR = 1.40). One possible reason for this finding is that self-diagnosis and self-triage tend to be associated with incorrect diagnoses and inappropriate treatment.[29] These findings suggest that it is important to receive timely non-routine care during a pandemic, regardless of the possibility of infection.

Running out of drugs and disruptions in routine clinical settings were also related to performance at work. The finding about medication is consistent with a previous study of depression, which showed that depressed employees often experience long-term loss of work performance when they run out of drugs.[30] Our study also demonstrated that disruptions in routine clinical settings showed a relatively weak association with reduced productivity at work (aOR = 1.67) when compared with running out of drugs (aOR = 2.58) or disruptions in non-routine clinical settings (aOR = 2.34). Family doctors

tried to offer patients routine care visits during the COVID-19 pandemic whenever they showed symptoms of exacerbated clinical conditions.[12] Postponement by family doctors therefore probably did not have much influence on presenteeism. These findings suggest that support for continued medication and timely non-routine hospital visits, rather than routine hospital visits, would help workers to maintain their productivity at work. Such support might include telemedicine and drug delivery services.[31]

This study has some limitations. Because of the study's cross-sectional design, causal relations among disrupted care, health status, and productivity loss could not be established. To cope with this limitation, we asked about each issue using different time periods: experience of disrupted care during the COVID-19 state of emergency (April and May 2020) and work performance 3 months later (August and September 2020). However, recall bias may have been an issue. Furthermore, workers who experienced disrupted care might have been more likely to remember health problems, which may have caused an overestimation of productivity loss. In addition, cases of resumed care during this 3-month period may have attenuated the effects of disrupted care. Another limitation is that we did not specify which underlying disease was associated with disrupted care. We also did not evaluate whether underlying diseases developed before or after the outbreak of the COVID-19 pandemic. We adjusted for potential causes in the statistical analysis, but future studies should consider this issue to clarify the relationship between underlying diseases and disrupted care. Additionally, the response rate of this study was relatively low (12.5%). The results should also be interpreted carefully because of the healthy worker effect. Despite these limitations, this study revealed an occupational health problem emerging during the COVID-19

pandemic and drew on a large sample of nationwide data.

In conclusion, our study showed that workers who experienced disrupted care were much more likely than others 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. Increasing accessibility of care for patients, for example by offering telemedicine appointments and drug delivery, could help workers to maintain their performance at work.

Authors' Contributions

TI conceived the research questions. TT designed the research protocol and collected the data. TI conducted the statistical analysis and drafted the initial manuscript with YF. KT, AH, MO and YY revised the manuscript. All the authors read and approved the final manuscript.

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Competing Interests

YF has received research grants and/or personal fees from NTT DATA MSE Corp.; The LOFT Co., Ltd.; Sompo Health Support Inc.; Asahi Shimbun Co.; Chugai Pharmaceutical Co., Ltd.; Asahi Kasei Pharma Co.; AstraZeneca K.K.; Pfizer Japan Inc.; Saibugas Co., Ltd.; Nippon Steel Co.; Hitachi Systems Ltd.; Mitsubishi Research Institute Inc.; and Institute for Building Environment and Energy Conservation.

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.

ORCID iDs

Tomohiro Ishimaru https://orcid.org/0000-0002-9334-1423

Kanami Tsuno https://orcid.org/0000-0001-9399-6596

Ai Hori https://orcid.org/0000-0002-0191-5996

Makoto Okawara https://orcid.org/0000-0002-2777-743X

Yoshihisa Fujino https://orcid.org/0000-0002-9126-206X

Takahiro Tabuchi https://orcid.org/0000-0002-1050-3125

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Figure legends

Figure 1. Flow chart of the study participants.

Table 1. Demographic characteristics of the participants

	n	(%)
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)	
	***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 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

	n	WFun ≥ 21 points %	Univariate OR	(95% CI)	*P*-value	Adjusted* OR	(95% CI)	*P*-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

	n	Exacerbation of underlying disease	Univariate			Adjusted*		
		%	OR	(95% CI)	*P*-value	OR	(95% CI)	*P*-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

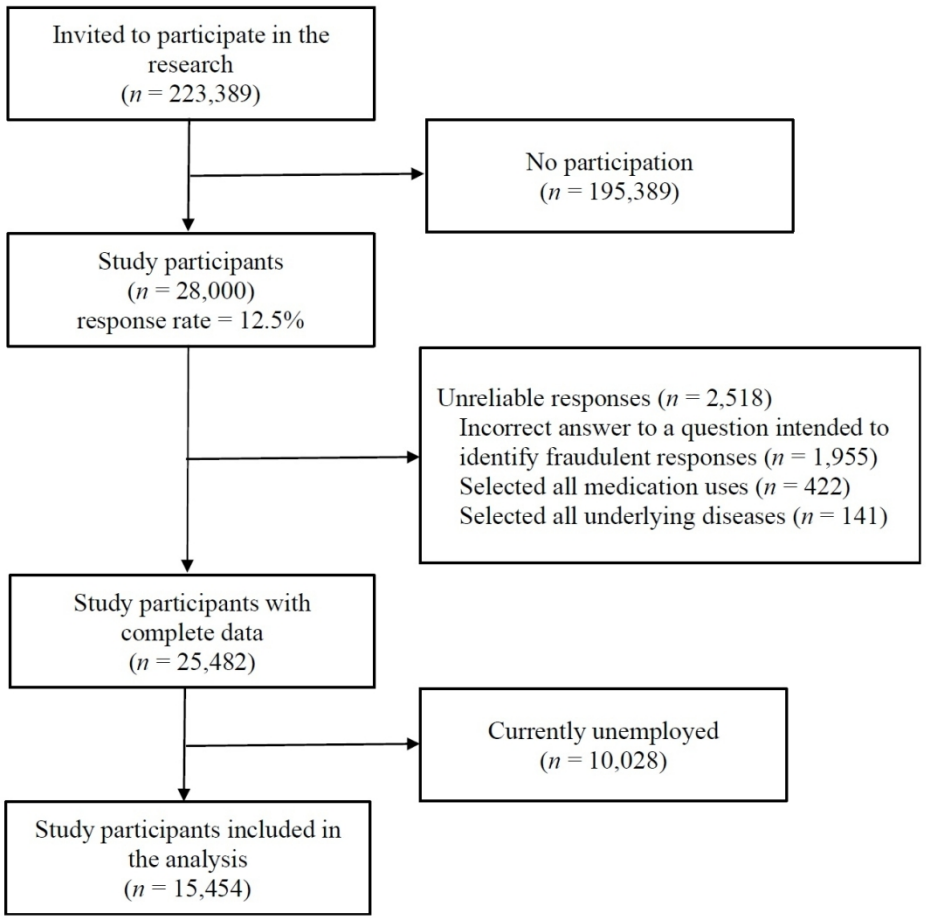

Figure 1. Flow chart of the study participants.

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

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	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
Introduction			
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
Methods			
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	
Results			

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
Discussion			
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
Other information			
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.