Association Between Abrupt Change to Teleworking and Physical Symptoms During the Coronavirus Disease 2019 (COVID-19) Emergency Declaration in Japan

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Objective: We investigated the association between telework frequency and the presence of non-COVID-19–related physical symptoms during the COVID-19 emergency declaration among workers in Japan. Methods: Data were collected from 1648 workers via web-based self-reported questionnaires. Multivariate logistic regression models were used to investigate the association between telework frequency per week (0, 1–2, 3–4, and ≥5 days/week) and the presence of stiff shoulders, eyestrain, and low back pain. Results: Among 917 participants, telework frequency was significantly associated with stiff shoulders (≥5 days: adjusted odds ratio [aOR] 3.02, 95% confidence interval [CI] 1.37–7.06), eyestrain (≥5 days: aOR 5.31, 95% CI 2.09–13.44), and low back pain (≥5 days: aOR 5.57, 95% CI 2.22–14.00), compared with non-teleworkers. Conclusions: Workers who abruptly began teleworking experienced more physical symptoms than non-teleworkers during the emergency declaration.

Learning Objectives
- Discuss previous reports on telework-related health problems that have emerged during the COVID-19 pandemic.
- Summarize the new findings on common types of physical symptoms developing after the COVID-19 emergency declaration among workers in Japan, and the associations of these symptoms with telework frequency.
- Discuss the study implications for managing telework-related symptoms in employees.
Additionally, workers with a higher telework frequency may have more physical symptoms. Given that many employers continued telework for a long period, it is important to assess physical symptoms among workers who abruptly began teleworking during the COVID-19 emergency declaration. The purpose of this study was to investigate the association between telework frequency and the presence of physical symptoms during the COVID-19 emergency declaration in Japan.

METHODS

Procedure and Participants
This cross-sectional study collected data from June to September 2020, which is after the COVID-19 emergency declaration. The subjects of this survey are workers of the companies collected from the recruitment by BackTech Inc. Two non-ferrous metal companies agreed to participate in this study and we distributed web-based self-reported questionnaires via the intranet to 4759 workers; 1648 workers completed the questionnaires (response rate: 34.6%). The inclusion criteria were full-time workers, aged ≥20 years, and non-teleworker before the emergency declaration (to target workers who abruptly began teleworking during the declaration). The exclusion criterion was having missing data. Data from 917 participants were available for statistical analysis.

This study was approved by the institutional ethics committee (approval no. R2-013). Informed consent was obtained from all participants prior to completing the web-based questionnaire.

Outcomes
The primary outcome was the presence of physical symptoms not due to COVID-19 infection during the emergency declaration. The presence of physical symptoms was assessed using the following question: “What physical symptoms concerned you during the emergency declaration?” Respondents selected from among 15 physical symptoms, chosen from the leading symptoms in the National Lifestyle Survey of Japan. The 15 symptoms were: stiff shoulders, eyestrain, low back pain, fatigue, sluggishness, cough and expectoration, frequent urination, constipation, joint pain, headache, diarrhea, dizziness, hearing loss, numbness in the fingers and forearms, and tinnitus. If participants had no physical symptoms, they responded “no symptoms.” Afterward, we used the prevalence of the three leading physical symptoms (stiff shoulders, eye strain, and low back pain) as the outcome variables.

Exposure
Based on the responses from the self-reported questionnaires, telework frequency during the emergency declaration was measured in telework days per week (response options were 0, 1, 2, 3, 4, and ≥5 days/week). We divided telework frequency into the following categories: 0, 1 to 2, 3 to 4, and ≥5 days per week. We constructed both crude and adjusted models. The following variables were included as covariates in the adjusted model: age, sex, body mass index, marital status, occupational status, and the presence of physical symptoms.

Other Variables
Data on the following demographic variables were obtained from the self-reported questionnaires: age, sex, height, weight, marital status (married, single, divorced, or widowed), occupational status (in a management position and not in a management position), occupation (general office clerks, engineering professionals, sales workers, science professionals, planning managers, human resource managers, customer services clerks, senior officials, personal care workers, and others), the presence of any of the 15 physical symptoms before the emergency declaration. Body mass index was calculated as weight in kilograms divided by height in meters squared.

Statistical Analysis
For descriptive data, categorical variables are presented as numbers and percentages. Continuous variables are described as the median and interquartile range (IQR). Logistic regression models were used to investigate the association between telework frequency and the presence of stiff shoulders, eyestrain, and low back pain during the emergency declaration. We constructed both crude and adjusted models. The following variables were included as covariates in the adjusted model: age, sex, body mass index, marital status, occupational status, and the presence of physical symptoms.

### TABLE 1. Participant characteristics (n = 917)

| Category                                      | Count (%)       |
|-----------------------------------------------|-----------------|
| Age (years), median (IQR)                     | 45 (34–52)      |
| Men, n (%)                                    | 714 (77.9)      |
| BMI (kg/m²), median (IQR)                     | 22.5 (20.6–25.0) |
| Marital status, n (%)                         | 598 (65.2)      |
| Married                                       | 298 (32.5)      |
| Single                                        | 21 (2.3)        |
| Divorced or widowed                           | 372 (40.6)      |
| Management position, n (%)                   | 575 (63.1)      |
| General office clerks                         | 85 (9.3)        |
| Engineering professionals                     | 444 (15.7)      |
| Sales workers                                 | 211 (23.0)      |
| Science professionals                         | 477 (52.0)      |
| Planning managers                             | 68 (7.4)        |
| Human resource managers                       | 43 (4.7)        |
| Customer services clerks                      | 42 (4.6)        |
| Senior officials                              | 33 (3.6)        |
| Personal care workers                         | 29 (3.2)        |
| Others                                        | 28 (3.1)        |
| Frequent urination                            | 26 (2.8)        |
| Cough and expectoration                       | 22 (2.4)        |
| Numbness of fingers and forearms              | 17 (1.9)        |
| Hearing loss                                  | 17 (1.9)        |
| No symptoms                                   | 317 (34.6)      |
| Physical symptoms before the emergency declaration, n (%) | 12 (1.3)          |
| Headache                                      | 333 (36.3)      |
| Eyestrain                                     | 299 (32.6)      |
| Low back pain                                 | 256 (27.9)      |
| Fatigue                                       | 178 (19.4)      |
| Sluggishness                                  | 146 (15.9)      |
| Headache                                      | 68 (7.4)        |
| Constipation                                  | 43 (4.7)        |
| Diarrhea                                      | 42 (4.6)        |
| Tinnitus                                      | 33 (3.6)        |
| Joint pain                                    | 29 (3.2)        |
| Dizziness                                     | 28 (3.1)        |
| Frequent urination                            | 26 (2.8)        |
| Cough and expectoration                       | 22 (2.4)        |
| Numbness of fingers and forearms              | 17 (1.9)        |
| Hearing loss                                  | 17 (1.9)        |
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| Hearing loss                                  | 17 (1.9)        |
| No symptoms                                   | 317 (34.6)      |
| Physical symptoms after the emergency declara- | 12 (1.3)        |
| tion, n (%)                                   | 317 (34.6)      |

BMI, body mass index; IQR, interquartile range.
before the emergency declaration (stiff shoulders, eyestrain, and low back pain). Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. P values <0.05 were considered statistically significant. All statistical analyses were performed using R version 4.0.2 (The R Project for Statistical Computing, Vienna, Austria).

RESULTS

Participant Characteristics
Among the 917 participants, the median age was 45 years (IQR: 34–52 years) and 77.9% were men. Eighty-five participants (9.3%) reported 0 days of telework during the emergency declaration, 144 (15.7%) reported 1 to 2 days, 211 (23.0%) reported 3 to 4 days, and 477 (52.0%) reported ≥5 days. The prevalence of the three leading physical symptoms during the emergency declaration was as follows: stiff shoulders (36.3% of participants), eyestrain (32.6%), and low back pain (27.9%) (see Table 1).

Association of Telework Frequency with Physical Symptoms during the Emergency Declaration
In the adjusted model, only 3 to 4 days and ≥5 days of teleworking per week had significant associations with the presence of stiff shoulders during the emergency declaration (3–4 days: OR = 3.02, 95% CI = 1.29–7.43; ≥5 days: OR = 3.02, 95% CI = 1.37–7.06) (see Table 2). Any frequency of teleworking was significantly associated with eyestrain during the emergency declaration in the adjusted model (1–2 days: OR = 3.62, 95% CI = 1.31–10.00; 3–4 days: OR = 3.88, 95% CI = 1.46–10.30; ≥5 days: OR = 5.31, 95% CI = 2.09–13.44) (see Table 3). The adjusted model also showed telework frequency was significantly associated with low back pain during the emergency declaration (1–2 days: OR = 3.83, 95% CI = 1.41–10.36; 3–4 days: OR = 6.09, 95% CI = 2.33–15.94; ≥5 days: OR = 5.57, 95% CI = 2.22–14.00) (see Table 4).

DISCUSSION
In this study, even after adjustment, higher telework frequency was significantly associated with a higher prevalence of stiff shoulders, eyestrain, and low back pain among workers in Japan during the COVID-19 emergency declaration. To the best of our knowledge, no studies have investigated the association between telework frequency and the presence of physical symptoms due to telework implemented without adequate preparation because of the COVID-19 pandemic.

A previous study found that, although the reported prevalence of low back pain was higher in teleworkers than non-teleworkers during the COVID-19 lockdown, the prevalence of neck pain showed no significant difference between teleworkers and non-teleworkers.13 These findings partially support our study results; however, covariates were not controlled in that study. In our study, we used multivariate analysis and adjusted for covariates, such as the presence of physical symptoms before the COVID-19 emergency declaration.

The association between telework frequency and stiff shoulders, eyestrain, and low back pain could be attributed to the following factors: 1) increased sitting time, 2) decreased physical activity, and 3) poor work environment at home. A previous study reported that in adults, physical activity has decreased and sitting time has increased during the COVID-19 pandemic.14 In general, sedentary behaviors can cause adverse effects on physical health.15 Indeed, increased sitting time has been associated with a higher risk for musculoskeletal pain, eyestrain, and fatigue.16–19 Therefore, increased sitting time may be a risk factor for stiff shoulders, eyestrain, and low back pain among teleworkers. A previous study reported that a prolonged sitting position may cause a continuous static load on the neck.

### TABLE 2. Logistic regression models for stiff shoulders during the emergency declaration

| Telework frequency | Prevalence of stiff shoulders, n (%) | Crude model | Adjusted model |
|--------------------|-------------------------------------|-------------|---------------|
|                    | OR 95% CI                           | OR 95% CI  |
| 0 day              | ref                                 | ref         |
| 1–2 days           | 2.22 1.19–4.34                       | 2.10 0.85–5.37 |
| 3–4 days           | 2.38 1.32–4.51                       | 3.02 1.29–7.43 |
| 5 or more days     | 2.93 1.69–5.37                       | 3.02 1.37–7.06 |

CI, confidence interval; OR, odds ratio.

### TABLE 3. Logistic regression models for eyestrain during the emergency declaration

| Telework frequency | Prevalence of eyestrain, n (%) | Crude model | Adjusted model |
|--------------------|--------------------------------|-------------|---------------|
|                    | OR 95% CI                       | OR 95% CI  |
| 0 day              | ref                             | ref         |
| 1–2 days           | 3.72 1.71–8.08                   | 3.62 1.31–10.00 |
| 3–4 days           | 4.19 1.98–8.86                   | 3.88 1.46–10.30 |
| 5 or more days     | 4.94 2.41–10.10                  | 5.31 2.09–13.44 |

CI, confidence interval; OR, odds ratio.

*Adjusted for age, sex, body mass index, marital status, occupational status, and stiff shoulders before the emergency declaration.

* *P* <0.05.
molecules, which is a risk factor for stiff shoulders. Further, previous studies have reported that increased work time using a visual display terminal (VDT) was significantly associated with eyestrain. Because many teleworkers use computers, it is likely that as sitting time increases, VDT work time also increases. Moreover, VDT work time may be increased in teleworkers because meetings often take place online. Regarding low back pain, previous studies have reported that intervertebral disc pressure is 1.4 times greater in a sitting position than a standing position, and that sitting for more than 7 hours per day significantly increases the risk of low back pain. Prolonged sitting may flex the spine and consequently place additional stress on the intervertebral discs. Furthermore, a decreased physical activity in leisure and commuting times, including walking and cycling, may have a negative impact on the physical symptoms among teleworkers. A previous study reported that the leisure physical activity of the workers decreased after the COVID-19 epidemic. Teleworkers may have spent less time performing any leisure physical activity than non-teleworkers. According to previous studies, less leisure physical activity was a risk factor for stiff shoulders and low back pain. Finally, in addition to physical activity and sedentary behavior, a poor work environment at home may also negatively affect physical symptoms among teleworkers. Among those who started telework during the COVID-19 pandemic, a poor working environment at home has been associated with a high level of discomfort in, for example, the head, eyes, and muscles.

To prevent the development of physical symptoms among teleworkers, it is important to reduce sitting time and increase leisure physical activity. It is likely that teleworkers experience increased sitting time because they communicate with colleagues online while seated and often work in a seated position with the computer at arm’s length. A previous study reported that light-intensity walking breaks may counteract the increased fatigue that arises from remaining in a continuously sedentary position. We encourage teleworkers to stand regularly with a computer or phone reminder every 2 hours. Therefore, teleworkers must have a good awareness of the importance of taking frequent breaks and reducing sitting time. Teleworkers should replace their commuting time with the performance of physical activities, such as walking, to ensure that they would have sufficient time for physical activity. The World Health Organization recommends that adults should perform at least 150 to 300 minutes of moderate-intensity aerobic physical activity or at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout a week. Finally, workers who are forced to begin teleworking abruptly may be unable to maintain their normal work environment and, therefore, may have difficulty in adapting to telework. Thus, it is also important for companies to educate the work environment teleworkers and supply them with office chairs with armrests, external monitors, keyboards, and computer mice.

### Limitations

This study had several limitations. First, because this was a cross-sectional study, causal relationships between telework frequency and physical symptoms during the emergency declaration remain unclear. However, we used multivariate analysis and adjusted for covariates such as the presence of physical symptoms before the emergency declaration. Thus, we were able to investigate the association between telework frequency and the presence of physical symptoms during the emergency declaration, by considering the presence of physical symptoms before the emergency declaration. However, there may be potential recall bias. Although the emergency declaration in Japan was declared from April 14 to May 25, 2020, participants completed the web-based questionnaires from June to September 2020. Finally, this sample might include selection bias due to the low response rate (34.6%) and the high percentage of men in the sample (77.9%). Because the web-based self-report questionnaires were distributed via the intranet, many workers may have been unaware this survey was being conducted.

### CONCLUSION

Our study showed that higher telework frequency was independently associated with a higher prevalence of physical symptoms during the COVID-19 emergency declaration in Japan. This finding suggests that greater attention is needed for the health of workers who must abruptly begin teleworking without adequate preparation.

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### TABLE 4. Logistic regression models for low back pain during the emergency declaration

| Telework frequency | Prevalence of low back pain, n (%) | Crude model | Adjusted model |
|--------------------|------------------------------------|-------------|---------------|
| 0 day              | 12 (14.1)                          | ref         | ref           |
| 1–2 days           | 43 (29.9)                          | 2.58        | 1.28–5.25*    |
| 3–4 days           | 57 (27.0)                          | 2.25        | 1.14–4.45*    |
| 5 or more days     | 144 (30.2)                         | 2.63        | 1.39–4.99*    |

CI, confidence interval; OR, odds ratio.

Adjusted for age, sex, body mass index, marital status, occupational status, and low back pain before the emergency declaration.

*P < 0.05.
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