








## ORIGINAL ARTICLE

# Low back pain and telecommuting in Japan: Influence of work environment quality

Ryutaro Matsugaki<sup>1</sup>  | Tomohiro Ishimaru<sup>2</sup>  | Ayako Hino<sup>3</sup>  | Keiji Muramatsu<sup>1</sup> | Tomohisa Nagata<sup>4</sup>  | Kazunori Ikegami<sup>5</sup>  | Seiichiro Tateishi<sup>6</sup>  | Mayumi Tsuji<sup>7</sup> | Shinya Matsuda<sup>1</sup> | Yoshihisa Fujino<sup>2</sup>  | CORoNaWork Project

<sup>1</sup>Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>2</sup>Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>3</sup>Department of Mental Health, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>4</sup>Department of Occupational Health Practice and Management, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>5</sup>Department of Work Systems and Health, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>6</sup>Department of Occupational Medicine, School of Medicine, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

<sup>7</sup>Department of Environmental Health, School of Medicine, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan

## Correspondence

Yoshihisa Fujino, Department of Environmental Epidemiology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Japan, 1-1, Iseigaoka, Yahatanishiku, Kitakyushu 807-8555, Japan.  
Email: zenq@med.uoeh-u.ac.jp

## Funding information

This study was supported and partly funded by the research grant from the University of Occupational and Environmental Health, Japan (no grant number); Japanese Ministry of Health, Labour and Welfare (H30-josei-ippan-002, H30-roudou-ippan-007, 19JA1004, 20JA1006, 210301-1, and 20HB1004); Anshin Zaidan (no grant number), the Collabo-Health Study Group (no grant number), and Hitachi Systems, Ltd. (no grant number) and scholarship donations from Chugai Pharmaceutical Co., Ltd. (no grant number).

## Abstract

**Objectives:** This study examined the relationship between frequency of working from home and low back pain (LBP), considering the quality of work environment.

**Methods:** The study was based on a cross-sectional internet-based survey. Of 33 302 respondents, data from 12 774 desk workers were retained for analysis. We used a 0–10 numerical rating scale to assess LBP. Work environment was assessed using five subjective questions. Mixed-effects logistic regression nested by city level was used to analyze the relationship between frequency of working from home and LBP, stratified by work environment condition.

**Results:** The prevalence of LBP was 21.0%. Among those reporting a poor work environment, as opposed to almost never working from home, the multivariate odds ratio (OR) of LBP were as follows: working from home less than 1 day per week: OR = 1.25, 95% CI: 0.89–1.76,  $p = .190$ ; 2–3 days per week: OR = 1.58, 95% CI: 1.16–2.16,  $p = .004$ ; and 4 or more days per week: OR = 1.82, 95% CI: 1.38–2.40,  $p < .001$ . By contrast, among those reporting a good work environment, the OR of LBP did not increase as the frequency of working from home increased.

**Conclusions:** The relationship between LBP and frequency of working from home was found to vary with the quality of the work environment; more

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2022 The Authors. *Journal of Occupational Health* published by John Wiley & Sons Australia, Ltd on behalf of The Japan Society for Occupational Health.

specifically, LBP was associated with frequency of teleworking in a poor work environment. This study suggests that employers should give more support to their employees in promoting a good work environment to prevent LBP. (Words: 240/250).

#### KEYWORDS

Japan, low back pain, telecommuting, work environment, work from home

## 1 | INTRODUCTION

Working from home (a form of “teleworking” or “telecommuting”) has been recommended worldwide since the outbreak of the coronavirus disease 2019 (COVID-19).<sup>1</sup> For example, the Japanese government has recommended work from home to counter the spread of COVID-19,<sup>2,3</sup> and the percentage of telework including work from home increased from 15.4% to 22.5% between October 2019 and November 2020.<sup>4</sup> Work from home is expected to become an increasingly common way of working in the future, but impacts of work from home on health are still largely unknown.

Currently, there is no consensus regarding the potential relationship between telework and lower back pain (LBP). A few recent studies have reported that work from home is associated with LBP.<sup>5–7</sup> Yoshimoto et al. reported an increased risk of LBP among workers who began teleworking and those who increased their frequency of telework during the COVID-19 pandemic.<sup>5</sup> Another report showed an association between the frequency of telework and the prevalence of LBP.<sup>7</sup> However, one report suggests that telework is not associated with exacerbation of LBP,<sup>8</sup> while another study reported a decrease in musculoskeletal pain including LBP among workers who teleworked in confinement due to the COVID-19 virus.<sup>9</sup>

Work from home and LBP may be associated with the quality of work environment. Previous studies have demonstrated such a relationship in office workers.<sup>10–13</sup> We reported that inadequate work environments (insufficient room to concentrate, and inadequate lighting, desk space and foot space) were associated with LBP among workers who work from home.<sup>14</sup> However, research on the relationship between the frequency of work from home and LBP that includes consideration of the quality of the work environment has yet to be conducted.

This study set out to examine the relationship between working from home and LBP, considering the quality of the work environment. Our hypothesis was that work from home and LBP are related when the work environment is poor, whereas they are not related when the latter is good.

## 2 | METHODS

### 2.1 | Study design and subjects

We conducted a cross-sectional internet-based survey between December 22 and December 26, 2020. More details about the survey protocol are available in another article.<sup>15</sup> The survey targeted people currently in possession of an employment contract. The exclusion criteria were (1) giving identifiably false responses, (2) being not mainly a desk worker, and (3) working less than 5 days per week. Of the 33 302 respondents, 12 774 were retained for the final analysis.

This study respected the principles of the Declaration of Helsinki, and received approval by the ethics committee of the University of Occupational and Environmental Health, Japan (reference No. R2-079 and R3-006). Participants gave informed consent online through the website.

### 2.2 | Assessment of LBP

As in our previous study,<sup>14</sup> participants' experience of LBP was assessed by their responses to two simple questions. The first question: “Have you experienced stiff shoulders or LBP in the past 2 weeks?” required a “yes” or “no” answer. If the participant answered “yes”, they continued to the following question, which focused on severity of LBP: “What was your average level of LBP in the past 2 weeks? (Please rate your pain from 0 to 10, where 0 = no pain at all and 10 = the most intense pain you have experienced).” We defined prevalent LBP as a pain intensity of 6 or higher, based on previous studies.<sup>16</sup>

### 2.3 | Assessment of telecommuting

Telecommuting status was assessed using the same question as in the previous study<sup>14</sup>: “Do you work at home? Please choose the answer that is closest to your current situation.” The respondents chose one of the five following options: 4 days a week or more, 2 to 3 days a week, 1 day a week, more than once a month

but less than once a week, and almost never. The answers “1 day a week” and “more than once a month but less than once a week” were classified together as “less than once a week.”

## 2.4 | Assessment of telecommuting environment

We used the following five items to categorize telecommuting environments: (1) “Do you have a place or room where you can concentrate on your work?” (2) “Is your desk well-enough lit for you to work?” (3) “Do you have enough space on your desk to work?” (4) “Is there enough space to stretch your legs?” (5) “Are the temperature and humidity in the room where you work appropriate for working comfortably?” These five questions were known to be related to prevalence of LBP in telecommuting workers.<sup>14</sup> The respondents answered “yes” or “no” to each question. For the analysis, a telecommuting environment was classified as “good” if the number of yes answers to the five questions was 3 or more, and “poor” if the number of answers was 2 or fewer.

## 2.5 | Assessment of participant characteristics and other covariates

In the analysis, we took into consideration the following socioeconomic factors: age, gender, body mass index (BMI), marital status, educational background (junior high school, high school, university or vocational school, junior college or technical college, or graduate school), and equivalent income (household income divided by the square root of the household size). Also included were the following lifestyle factors: smoking (currently smoking), drinking (consuming alcohol on two or more days per week), and physical activity (walking or equivalent physical activities) for at least 1 h a day for more than 2 days a week).

To assess mental health status, we used the Kessler 6 (K6),<sup>17</sup> the Japanese version of which was validated previously.<sup>18</sup> This tool was developed to screen for mental disorders including depression and anxiety. It consists of six questions, with answers to each ranging from 0 (never) to 4 (always), according to frequency of experiencing the event described in the question within the past 30 days. The higher total score, the greater the potential for depression or anxiety disorder. We used a K6 score  $\geq 5$  as an indicator of the presence of psychological distress.

The company size (total number of people employed by the company where the participant works) was recorded in one of four categories: 1–9, 10–99, 100–999, and over 1000.

## 2.6 | Statistical analysis

Age and BMI are expressed as continuous variables, using the mean and standard deviation. Other variables are presented categorically, using numerical values and percentages.

Mixed-effects logistic regression analysis nested by municipality level (cities, wards, towns, and villages) was conducted to analyze the relationship between telecommuting frequency and LBP. First, preliminary analysis confirmed a significant interaction between telecommuting frequency and telecommuting environment. Second, we estimated age–sex adjusted and multivariate adjusted odds ratios stratified by telecommuting environment. The multivariate model included age, sex, BMI, marital status, educational background, equivalent income, lifestyle habit, psychological distress, and company size.

All statistical analyses were performed with Stata software (Stata Statistical Software: Release 16; StataCorp LLC). Any *P*-values of  $<.05$  were considered statistically significant.

## 3 | RESULTS

Table 1 presents details of participant characteristics. Of the 12 774 workers, 9082 (71.1%) telecommuted almost never, 873 (6.8%) telecommuted less than 1 day per week, 953 (7.5%) 2 to 3 days a week, 1866 (14.6%) telecommuted 4 days a week or more. Regarding the telecommuting environment, the percentage of those reporting “good” was 60.6% (5505), 76.7% (670), 75.8% (722), and 84.5% (1577) in groups that telecommuted almost never, less than 1 day, 2 to 3 days, and 4 days a week or more, respectively. The overall prevalence of LBP was 21.0% (2686/12 774 workers).

The odds ratios of LBP associated with telecommuting frequency stratified by telecommuting environment are shown in Table 2. Among participants who had a good telecommuting environment, the odds ratios of LBP did not increase as telecommuting frequency increased. Outside of those who almost never telecommuted, the multivariate odds ratios of LBP in those who telecommuted less than 1 day per week, 2 to 3 days per week, and 4 days per week or more, were 1.15 (95% CI: 0.94–1.41,  $p = .176$ ), 1.17 (95% CI: 0.96–1.43,  $p = .113$ ), and 1.03 (95% CI: 0.88–1.21,  $p = .705$ ), respectively. By contrast, among those who had a poor telecommuting environment, the odds ratios of LBP did increase as telecommuting frequency increased. Again disregarding those who almost never telecommuted, the multivariate odds ratios of LBP were 1.25 (95% CI: 0.89–1.76,  $p = .190$ ), 1.58 (95% CI: 1.16–2.16,  $p = .004$ ), and 1.82

TABLE 1 Participant characteristics

	Frequency of telecommuting			
	Almost never	≤1 d/w	2–3 d/w	≥4 d/w
	<i>n</i> = 9082	<i>n</i> = 873	<i>n</i> = 953	<i>n</i> = 1866
Age, mean (SD)	47.2 (10.2)	47.8 (10.1)	47.9 (10.2)	48.9 (10.1)
Male gender	4363 (48.0%)	569 (65.2%)	539 (56.6%)	1077 (57.7%)
Body mass index, mean (SD)	22.3 (3.7)	22.5 (3.4)	22.3 (3.6)	22.5 (3.7)
Marital status				
Married	5295 (58.3%)	581 (66.6%)	584 (61.3%)	925 (49.6%)
Divorced/widowed	900 (9.9%)	52 (6.0%)	59 (6.2%)	168 (9.0%)
Unmarried	2887 (31.8%)	240 (27.5%)	310 (32.5%)	773 (41.4%)
Educational background				
Junior high school	55 (0.6%)	2 (0.2%)	4 (0.4%)	14 (0.8%)
High school	2269 (25.0%)	117 (13.4%)	89 (9.3%)	314 (16.8%)
University-	6758 (74.4%)	754 (86.4%)	860 (90.2%)	1538 (82.4%)
Equivalent income (10 000 yen)				
–260	2586 (28.5%)	138 (15.8%)	157 (16.5%)	616 (33.0%)
261–425	2387 (26.3%)	180 (20.6%)	215 (22.6%)	349 (18.7%)
426–530	2198 (24.2%)	253 (29.0%)	247 (25.9%)	389 (20.8%)
531–	1911 (21.0%)	302 (34.6%)	334 (35.0%)	512 (27.4%)
Lifestyle habit				
Smoking (yes)	2140 (23.6%)	245 (28.1%)	234 (24.6%)	453 (24.3%)
Drinking (≥2 days/week)	3695 (40.7%)	429 (49.1%)	464 (48.7%)	811 (43.5%)
Physical activity (≥2 days/week)	2415 (26.6%)	352 (40.3%)	406 (42.6%)	637 (34.1%)
Psychological distress (K6 ≥ 5)	3536 (38.9%)	338 (38.7%)	349 (36.6%)	714 (38.3%)
Telecommuting environment <sup>a</sup>				
Poor	3577 (39.4%)	203 (23.3%)	231 (24.2%)	289 (15.5%)
Good	5505 (60.6%)	670 (76.7%)	722 (75.8%)	1577 (84.5%)
Company size (persons)				
–9	1277 (14.1%)	69 (7.9%)	98 (10.3%)	954 (51.1%)
10–99	2596 (28.6%)	143 (16.4%)	154 (16.2%)	166 (8.9%)
100–999	2709 (29.8%)	249 (28.5%)	254 (26.7%)	253 (13.6%)
1000–	2500 (27.5%)	412 (47.2%)	447 (46.9%)	493 (26.4%)
Low back pain	1875 (20.6%)	196 (22.5%)	224 (23.5%)	391 (21.0%)

<sup>a</sup>The telecommuting environment was assessed with the following questions: (1) “Do you have a place or room where you can concentrate on your work?” (2) “Is your desk well-enough lit for you to work?” (3) “Do you have enough space on your desk to work?” (4) “Is there enough space to stretch your legs?” (5) “Are the temperature and humidity in the room where you work were appropriate for working comfortably?” We defined “good” as three or more questions answered “yes”, and “poor” as two or fewer questions answered “yes”.

(95% CI: 1.38–2.40,  $p < .001$ ) for the less than 1 day per week group, 2 to 3 days a week, and 4 days a week or more groups, respectively.

## 4 | DISCUSSION

The relationship between LBP and work from home differed depending on the telecommuting environment. The results showed that there was no association between LBP and

work from home when the work environment was good, whereas the prevalence of LBP increased with the frequency of work from home when the work environment was poor.

This study revealed that some people who work from home are doing so in poor work environments. While the survey was being conducted, the Japanese government responded to the rapid spread of COVID-19 by recommending the implementation of work from home to curb the spread of infection.<sup>2,3</sup> As a consequence, telecommuting may have been imposed involuntarily, regardless of the

TABLE 2 Odds ratio of low back pain associated with frequency of work from home stratified by work environment

	Age–sex adjusted				Multivariate <sup>a</sup>			
	OR	95%CI		P	OR	95%CI		P
All participants (n = 12 774)								
Frequency of telecommuting								
Almost never	Reference				Reference			
≤1 d/w	1.16	0.98	1.37	.082	1.18	0.99	1.41	.060
2–3 d/w	1.21	1.03	1.41	.021	1.27	1.08	1.50	.005
≥4 d/w	1.05	0.93	1.19	.437	1.15	1.01	1.32	.040
					0.109*			.003*
Participants with a good telecommuting environment <sup>b</sup> (n = 8474)								
Frequency of telecommuting								
Almost never	Reference				Reference			
≤1 d/w	1.13	0.92	1.37	.238	1.15	0.94	1.41	.176
2–3 d/w	1.11	0.92	1.34	.282	1.17	0.96	1.43	.113
≥4 d/w	0.94	0.82	1.09	.431	1.03	0.88	1.21	.705
				.754*				.340*
Participants with a poor telecommuting environment <sup>b</sup> (n = 4300)								
Frequency of telecommuting								
Almost never	Reference				Reference			
1 d/w	1.31	0.94	1.81	.111	1.25	0.89	1.76	.190
2–3 d/w	1.57	1.17	2.11	.003	1.58	1.16	2.16	.004
≥4 d/w	1.80	1.39	2.34	<.001	1.82	1.38	2.40	<.001
				<.001*				<.001*

Note: We defined "good" as three or more questions answered "yes," and "poor" as two or fewer questions answered "yes."

<sup>a</sup>The multivariate model adjusted for age, gender, body mass index, marital status, educational background, equivalent income, lifestyle habit (smoking, drinking, and physical activity), psychological status, and company size.

<sup>b</sup>The telecommuting environment was assessed with the following questions: (1) "Do you have a place or room where you can concentrate on your work?" (2) "Is your desk well-enough lit for you to work?" (3) "Do you have enough space on your desk to work?"; (4) "Is there enough space to stretch your legs?" (5) "Are the temperature and humidity in the room where you work were appropriate for working comfortably?"

\*P-value of trend.

quality of the work environment. In a survey conducted contemporaneously with this survey, fewer than 50% of Japanese workers reported having a work desk and chair in their home that were suitable for work from home.<sup>4</sup> In this study, it was also shown that 15.5% of workers worked from home in a poor work environment even if they do so more than 4 times a week.

Our data revealed that the relationship between working from home and LBP was clearly different depending on whether the telecommuting practice was maintained or not. Tezuka et al. reported a relationship between frequency of work from home and physical symptoms including LBP in Japanese workers who started work from home under COVID-19,<sup>7</sup> but the dose-response relationship between LBP and frequency of work from home was not clear. Although that study did not focus on the participants' work environment, it is possible that there was a mix of home workers with good and bad work environments.

In this study, no dose–response relationship between frequency of work from home and LBP was clear when the work environment was not taken into consideration.

We found a dose–response relationship between the prevalence of LBP and the frequency of work from home when the work environment was poor. Awkward posture is known to be a risk factor for LBP.<sup>10,13,19</sup> Inadequate illumination of desks and inadequate space around desks can result in LBP by forcing workers into awkward postures. Cold temperatures are also a known risk factor for LBP.<sup>11,20–22</sup> Suboptimal temperature and humidity in rooms used for work from home can lead to LBP by increasing muscle tension in workers' lower back. Furthermore, psychological stress is also considered to be a risk factor for LBP,<sup>23–25</sup> and the lack of a room dedicated to work from home may cause LBP in workers by increasing their psychological stress.

As the work environment of telecommuters is closely related to their personal life, it is more difficult than an

office environment for employers to manage.<sup>14</sup> Therefore, employers need to provide workers who work from home with information and education on appropriate work environments so that they can manage themselves. For instance, the guidelines issued by the Ministry of Health, Labor and Welfare<sup>26,27</sup> may be useful, as they provide recommended telecommuting environment levels for lighting, temperature, humidity, etc.

This study has some limitations. First, the work environment was evaluated using subjective questions. Temperature and humidity could have been measured using a thermometer or hygrometer, and desk illumination could have been measured using an illuminance meter. However, there is currently no objective way to evaluate the space around a desk or a room where one can focus on work. Second, there is the problem of unmeasured confounds. It is known that factors such as position of the computer display,<sup>11</sup> sitting time,<sup>10</sup> and past symptoms<sup>28</sup> affect LBP in workers, but these were not considered here. Whether these factors might have influenced our results is not clear. Third, this study did not consider the duration of workers' telecommuting engagement. It has been suggested that there is a higher risk of musculoskeletal symptoms when exposure level (duration) increases (dose-response relationship).<sup>29,30</sup> If a large number of workers who teleworked on an emergency or temporary basis due to the Covid-19 epidemic is included, the relationship between inappropriate telecommuting environments and back pain may be underestimated. Finally, because of the study's cross-sectional design, we cannot draw conclusions about any causal relationship. However, it seems unlikely that workers suffering from LBP would arrange the work environment in a way that would exacerbate their problem.

## 5 | CONCLUSION

We found that the relationship between LBP and work from home differed depending on the quality of the work environment. The evidence suggests that LBP is associated with work from home when the work environment is poor. Employers need to appreciate the importance of the telecommuting environment when asking employees to work from home. They should offer advice about appropriate work environments both when the environment for work from home has not yet been set up, and when it is already being used.

## ACKNOWLEDGEMENT

This study was supported and partly funded by the research grant from the University of Occupational and Environmental Health, Japan (no grant number); Japanese Ministry of Health, Labour and Welfare (H30-josei-ippan-002, H30-roudou-ippan-007, 19JA1004, 20JA1006, 210301-1, and 20HB1004); Anshin Zaidan (no grant

number), the Collabo-Health Study Group (no grant number), and Hitachi Systems, Ltd. (no grant number) and scholarship donations from Chugai Pharmaceutical Co., Ltd. (no grant number). The funder was not involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication. All authors declare no other competing interests.

The current members of the CORoNaWork Project, in alphabetical order, are as follows: Dr. Yoshihisa Fujino (present chairperson of the study group), Dr. Akira Ogami, Dr. Arisa Harada, Dr. Ayako Hino, Dr. Hajime Ando, Dr. Hisashi Eguchi, Dr. Kazunori Ikegami, Dr. Kei Tokutsu, Dr. Keiji Muramatsu, Dr. Koji Mori, Dr. Kosuke Mafune, Dr. Kyoko Kitagawa, Dr. Masako Nagata, Dr. Mayumi Tsuji, Ms. Ning Liu, Dr. Rie Tanaka, Dr. Ryutaro Matsugaki, Dr. Seiichiro Tateishi, Dr. Shinya Matsuda, Dr. Tomohiro Ishimaru, and Dr. Tomohisa Nagata. All members are affiliated with the University of Occupational and Environmental Health, Japan.

## DISCLOSURE

*Approval of the research protocol:* This study conformed to the principles of the Declaration of Helsinki and was approved by the ethics committee of the University of Occupational and Environmental Health, Japan (reference No. R2-079 and R3-006). *Informed Consent:* Informed consent was obtained from all participants through the website. *Registry and the Registration No. of the study/trial:* N/A. *Animal studies:* N/A. *Conflict of interest:* The authors declare no conflicts of interest associated with this manuscript.

## AUTHOR CONTRIBUTIONS

Conceptualization, R.M.; Methodology, R.M. and Y.F.; Formal Analysis, R.M. and Y.F.; Investigation, R.M., T.I., A.H., K.M., T.N., K.I., S.T., M.T., S.M. and Y.F.; Writing—Original Draft Preparation, R.M.; Writing—Review and Editing, T.I., A.H., K.M., T.N., K.I., S.T., M.T., and S.M.; Supervision, Y.F.; Project Administration, Y.F.; Funding Acquisition, T.I., S.T., M.T., S.M., and Y.F.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ORCID

Ryutaro Matsugaki  <https://orcid.org/0000-0001-9401-1939>

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

Ayako Hino  <https://orcid.org/0000-0002-4051-5311>

Tomohisa Nagata  <https://orcid.org/0000-0001-9173-420X>

Kazunori Ikegami  <https://orcid.org/0000-0001-5486-8639>

Seiichiro Tateishi  <https://orcid.org/0000-0002-9774-6479>

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

## REFERENCES

1. World Health Organization. *Getting Your Workplace Ready for COVID-19: How COVID-19 Spreads*. World Health Organization; 2020. <https://www.who.int/publications/m/item/getting-your-workplace-ready-for-covid-19-how-covid-19-spreads>
2. Ministry of Health, Labour and Welfare. *Decisions by the Headquarters for Novel Coronavirus Disease Control. Basic Policies for Novel Coronavirus Disease Control*. Ministry of Health, Labour and Welfare; 2020. <https://www.mhlw.go.jp/content/10200000/000603610.pdf>
3. Ministry of Health, Labour and Welfare. *Decisions by the Headquarters for Novel Coronavirus Disease Control. Basic Policies for Novel Coronavirus Disease Control*. Ministry of Health, Labour and Welfare. 2020. <https://www.mhlw.go.jp/content/10900000/000620733.pdf>
4. Ministry of Land, Infrastructure, Transport and Tourism. *Vital Statistics of Telework (in Japanese)*. Ministry of Land, Infrastructure, Transport and Tourism. 2021. <https://www.mlit.go.jp/toshi/daisei/content/001392107.pdf>
5. Yoshimoto T, Fujii T, Oka H, Kasahara S, Kawamata K, Matsudaira K. Pain status and its association with physical activity, psychological stress, and telework among Japanese workers with pain during the COVID-19 pandemic. *Int J Environ Res Public Health*. 2021;18(11):1660-4601.
6. Šagát P, Bartík P, González PP, Tohánean DI, Knjaz D. Impact of COVID-19 quarantine on low back pain intensity, prevalence, and associated risk factors among adult citizens residing in Riyadh (Saudi Arabia): a cross-sectional study. *Int J Environ Res Public Health*. 2020;17(19):1-13.
7. Tezuka M, Nagata T, Saeki K, Tsuboi Y, Fukutani N. Association between abrupt change to teleworking and physical symptoms during the coronavirus disease 2019 (COVID-19) emergency declaration in Japan. *J Occup Environ Med*. 2022;64(1):1-5.
8. Moretti A, Menna F, Alicino M, Paoletta M, Liguori S, Iolascon G. Characterization of home working population during covid-19 emergency: a cross-sectional analysis. *Int J Environ Res Public Health*. 2020;17(17):1-13.
9. Rodríguez-Nogueira Ó, Leirós-Rodríguez R, Benítez-Andrades JA, Álvarez-Álvarez MJ, Marqués-Sánchez P, Pinto-Carral A. Musculoskeletal pain and teleworking in times of the COVID-19: analysis of the impact on the workers at two Spanish universities. *Int J Environ Res Public Health*. 2020;18(1):31.
10. Spyropoulos P, Papathanasiou G, Georgoudis G, Chronopoulos E, Koutis H, Koumoutsou F. Prevalence of low back pain in Greek public office workers. *Pain Phys*. 2007;10(5):651-659.
11. Ye S, Jing Q, Wei C, Lu J. Risk factors of non-specific neck pain and low back pain in computer-using office workers in China: a cross-sectional study. *BMJ Open*. 2017;7(4).
12. Kaliniene G, Ustinaviciene R, Skemiene L, Vaiciulis V, Vasilavicius P. Associations between musculoskeletal pain and work-related factors among public service sector computer workers in Kaunas County, Lithuania. *BMC Musculoskelet Disord*. 2016;17(1):1-12.
13. Janwantanakul P, Pensri P, Moolkay P, Jiamjarasrangsi W. Development of a risk score for low back pain in office workers - a cross-sectional study. *BMC Musculoskelet Disord*. 2011;12(23).
14. Matsugaki R, Muramatsu K, Tateishi S, et al. Association between telecommuting environment and low back pain among Japanese telecommuting workers. *J Occup Environ Med*. 2021;63(12):e944-e948.
15. Fujino Y, Ishimaru T, Eguchi H, et al. Protocol for a nationwide internet-based health survey of workers during the COVID-19 pandemic in 2020. *J UOEH*. 2021;43(2):217-225.
16. Boonstra AM, Stewart RE, Köke AJA, et al. Cut-off points for mild, moderate, and severe pain on the Numeric Rating Scale for Pain in patients with chronic musculoskeletal pain: variability and influence of sex and catastrophizing. *Front Psychol*. 2016;7:1466.
17. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*. 2002;32(6):959-976.
18. Furukawa TA, Kawakami N, Saitoh M, et al. The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. *Int J Methods Psychiatr Res*. 2008;17(3):152-158.
19. Liira JP, Shannon HS, Chambers LW, Haines TA. Long-term back problems and physical work exposures in the 1990 Ontario health survey. *Am J Public Health*. 1996;86(3):382-387.
20. Jin K, Sorock GS, Courtney T, et al. Risk factors for work-related low back pain in the People's Republic of China. *Int J Occup Environ Health*. 2000;6(1):26-33.
21. Dovrat E, Katz-Leurer M. Cold exposure and low back pain in store workers in Israel. *Am J Ind Med*. 2007;50(8):626-631.
22. Skandfer M, Talykova L, Brenn T, Nilsson T, Vaktskjold A. Low back pain among mineworkers in relation to driving, cold environment and ergonomics. *Ergonomics*. 2014;57(10):1541-1548.
23. Vinstrup J, Jakobsen MD, Andersen LL. Perceived stress and low-back pain among healthcare workers: a multi-center prospective cohort study. *Front Public Health*. 2020;8:297.
24. Tsuboi Y, Ueda Y, Naruse F, Ono R. The association between perceived stress and low back pain among eldercare workers in Japan. *J Occup Environ Med*. 2017;59(8):765-767.
25. Yoshimoto T, Oka H, Katsuhira J, et al. Prognostic psychosocial factors for disabling low back pain in Japanese hospital workers. *PLoS One*. 2017;12(5):e0177908.
26. Ministry of Health, Labour and Welfare. *Guidelines for the Promotion of Appropriate Introduction and Implementation of Telework (in Japanese)*. Ministry of Health, Labour and Welfare; 2021. [https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou\\_roudou/roudoukijun/shigoto/guideline.html](https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/roudoukijun/shigoto/guideline.html)
27. Ministry of Health, Labour and Welfare. *Work Environment Maintenance for Teleworking at Home (in Japanese)*. Ministry of Health, Labour and Welfare; 2020. [https://www.mhlw.go.jp/stf/newpage\\_01603.html](https://www.mhlw.go.jp/stf/newpage_01603.html)
28. Juul-Kristensen B, Søgaard K, Strøyer J, Jensen C. Computer users' risk factors for developing shoulder, elbow and back symptoms. *Scand J Work Environ Health*. 2004;30(5):390-398.
29. Montreuil S, Lippel K. Telework and occupational health: a Quebec empirical study and regulatory implications. *Saf Sci*. 2003;41:339-358.
30. Bouziri H, Smith DRM, Descatha A, Dab W, Jean K. Working from home in the time of COVID-19: how to best preserve occupational health? *Occup Environ Med*. 2020;77:509-510.

**How to cite this article:** Matsugaki R, Ishimaru T, Hino A, et al; CORoNaWork Project. Low back pain and telecommuting in Japan: Influence of work environment quality. *J Occup Health*. 2022;64:e12329. doi:[10.1002/1348-9585.12329](https://doi.org/10.1002/1348-9585.12329)