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Research article

Effects of a Short-Term Telework Program in a Local City with Business Travel on Stress Indicators among Workers in a Japanese Metropolitan Area: A Preliminary Study

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Abstract

Working in an unusual location may affect an individual's stress state. In this study, we provided a short-term telework program with business trips to a local city rich in natural scenery to workers from a large city, and examined the effects of the program on their stress levels. Thirty-seven workers (30 males and 7 females) aged 39 (9) years old were included in the study, which was conducted in a single-arm trial in which all subjects received the same program. The program was conducted over a period of 3 to 5 days and consisted of regular telework duties, in addition to yoga and social gatherings with residents. Mood disturbance, salivary amylase activity, blood pressure, and physical activity were assessed before, during, and after the program. Compared to the pre-program, the total mood disturbance score (12.8 [18.3] to -0.3 [15.0], $p < 0.05$) and salivary amylase activity before the start of work (28.4 [19.3] to 14.5 [6.4], $p < 0.05$) were significantly lower during the program. However, after the program, these items began to increase again. In conclusion, it is suggested that a telework program in a local city for workers from a large city may improve workers' stress levels. On the other hand, it was also found that this program temporarily reduced physical activity.

Keywords: Telework, stress, business travel, salivary amylase activity, physical activity

Introduction

The deterioration of mental health among workers is currently a major problem in Japan. The Ministry of Health, Labour and Welfare's "Patient Survey" estimates that there were approximately 1.28 million patients with mood (emotional) disorders in 2017, and the number is increasing for both men and women [1]. In addition, the Survey on State of Employees' Health of 2018 reported that 6.7% of all establishments had workers who were absent from work for one or more consecutive months due to mental health problems, and 5.8% of all establishments had workers who resigned [2]. Mental health problems not only significantly worsen the health of individual workers, but also lead to decreased productivity for business establishments, so it is important to take action (prevention and improvement) from an early stage.

However, it has been reported that merely implementing stress checks is not enough to solve mental health problems, and that it is important to accompany these with improvements in the work environment [3,4]. In addition to workplace improvement, self-care training and education of managers are also recommended for primary prevention of workers' mental health problems [5]. In other words, from the viewpoint of workplace improvement, workers should show initiative in improving the work environment and working conditions that may be related to physical and mental burden, with the involvement of the person in charge [6]. In terms of self-care, workplaces should provide workers with appropriate stress management programs for individuals [7], and in terms of management education, managers should participate in stress management training to learn how to deal with their subordinates as well as the entire workplace.

In this context, "work style reform" was promoted by the Japanese government with the enactment of the "Act on the Arrangement of Related Acts to Promote Work Style Reform" in 2018. In addition to regulating working hours and ensuring fairness in treatment, it also includes the creation of an environment that

facilitates flexible work styles. This environment also includes mental health measures and the promotion of work styles that do not require a specific work location (i.e., telework and remote work). A change in the physical work environment is a stressor in itself, and may have effects on the body and mind [8]. For example, it has been reported that brain activity related to essential processes while working (e.g., concentration) seems to be perturbed when the surrounding acoustic environment is unpleasant [9], and that visual stimulation from the natural environment suppresses negative emotions [10]. It is possible that appropriate manipulation and modification of the work environment can reduce stress.

Kawakubo et al. reported that a short-term trip designed to improve the mental health of workers in Tokyo significantly reduced stress compared to a control group [11]. Although this previous study was a leisure trip designed to improve mental health and included various training programs, it could indicate the effectiveness of leaving the current living area, even temporarily, in terms of reducing stress. If we assume that the physical environment has an effect on stress at work, it is possible that workers in large metropolitan areas can experience beneficial effects on their mental health through working in a place with a rich natural environment. However, in the context of telework in the reform of work styles, research has not examined how working away from the traditional work environment affects stress. Therefore, the purpose of this study was to examine the effects of business trip with telework in a local city on stress among workers who live and work in a metropolitan area.

Methods

Participants

The subjects who participated in this study were adult workers who worked for information and communications companies headquartered in the Tokyo metropolitan area and metropolitan areas (Aichi and Osaka prefectures and their suburbs), and 40 people from eight companies (2-11 people/company, 32 males and 8 females) who voluntarily announced their participation in response to the request for the program via their company representatives. The recruitment of participants was conducted from May to October 2019. After recruitment, the study was explained to the subjects in writing and orally, and written consent was obtained after the subjects fully understood the purpose of this study. This study was conducted in accordance with the Declaration of Helsinki, and was approved by the Research Ethics Review Committee of the Faculty of Human Sciences, Shimane University (Approval No. 18).

Thirty-seven subjects (30 males and 7 females) were included in the final analysis, excluding three subjects who were deficient in all major measurement and survey items.

Study design

In this study, we examined changes in stress, physical activity, and other factors due to the implementation of telework in Matsue City, Shimane Prefecture, using a single-group pre/post comparison design. The subjects underwent pre-measurement one to three weeks before the program, participated in the program for 3 to 5 days, and underwent post-measurement. The duration of the program was set in consideration of the circumstances of the participating companies, and measurements and surveys were also conducted during the program.

Program

The program in this study was conducted in Matsue City, Shimane Prefecture. Matsue City, the capital of the prefecture, is located by the Sea of Japan, between the Sea of Japan on the north and the Chugoku Mountains on the south, facing Lake Shinji and Naka Sea. It is also known as the “City of Water” because of its rich forest and waterfront environment. The program was provided to the participants according to the itinerary shown in Table 1, although there were some differences depending on the company they belonged to. In other words, on the first day, the participants moved in the morning and started teleworking in the afternoon, teleworked all day on the second day, and teleworked in the morning on the last day, after which they were free to leave. In the early morning and before bedtime during the program, participants practiced yoga under the guidance of instructors and social networking events were set to ensure participants interacting with local residents to create a relaxed atmosphere for their stay.

Table 1. Itinerary of the Telework Program

	Time zone	Contents
First day	Morning	Traveling (to Matsue City)
	Afternoon	Guidance and telework
	Night	Networking event with dinner
	Before going to bed	Yoga
Second day	Early morning	Yoga
	Morning	Telework
	Afternoon	Telework
	Night	An introduction to Izumo mythology by a storyteller
	Before going to bed	Yoga
Third/Fourth day	Early morning	Yoga or walking
	Morning	Tour of Miho Shrine or telework (making their own choice)
	Afternoon	Telework
	Before going to bed	Yoga
Final day	Early morning	Walking
	Morning	Telework
	Afternoon	Closing

Telework was conducted at two facilities in Matsue City (an old private house-type shared office in the city center on the first day, and a guesthouse in a suburban area rich in natural scenery on the second and subsequent days: Figure), providing an environment different from the usual work environment for the participants. Wi-Fi, monitors, booths for video conferencing, and meeting spaces for multiple people were provided so as not to interfere with work.

Yoga was practiced early in the morning (around 7:00 a.m.) and before bedtime (around 10:00 p.m.) to reduce the stress associated with work. The duration of the yoga class was 45 to

Figure 1. Photo of working in a place rich in natural scenery.

60 minutes, and the instructor provided face-to-face guidance to increase wakefulness in the early morning and relaxation before bedtime to help the participants fall asleep smoothly.

The program included a dinner party, an introduction to Izumo mythology by a storyteller, and a tour of Miho Shrine (Mihonoseki-cho, Matsue City, Shimane Prefecture) and its vicinity by a professional guide.

Measurements

In this study, data on blood pressure, pulse rate, salivary amylase activity, and mood (assessed using the Profile of Mood States 2nd Edition; POMS 2) were collected as indicators to evaluate physical and mental stress responses. In addition, the amount of physical activity was measured to examine the effect of program implementation on physical activity.

Blood pressure and pulse

Blood pressure has been found to increase with activation the sympathetic nervous system. Pulse rate is the same as heart rate unless there is an arrhythmia, and like blood pressure, pulse rate is also known to be influenced by the autonomic nervous system. Systolic blood pressure, diastolic blood pressure, and pulse were self-measured using an automatic blood pressure monitor (HEM-7500, Omron Healthcare) after at least 5 minutes of sitting rest. In principle, measurements were taken once at same time every day, and a second measurement was taken if the subject judged that the values were farther apart than usual. Measurements were taken one week (3 days) before the program, during the program (3-5 days), and one week (3 days) after the program.

Salivary amylase activity

The activity of alpha-amylase in saliva, a type of digestive enzyme, has been found to be affected by catecholamines from the adrenal medulla due to sympathetic nervous tension [12]. Salivary amylase activity was self-measured using a dry clinical chemistry analyzer (Salivary amylase monitor, Nipro Corporation) [13] at the same time as blood pressure and pulse measurements. As a rule, measurement was performed once, and a second measurement was performed only when an error occurred. As with the blood pressure and pulse measurements, the measurements were conducted one week before the program (3 days), during the program (3-5 days), and one week after the program (3 days), and were taken before the start of work and after work.

Profile of mood states

Mood disturbance was measured using a shortened version (35 items) of the POMS 2 [14,15]. The POMS 2 consists of five negative subscales (Anger-Hostility, Confusion-Bewilderment, Depression-Dejection, Fatigue- Inertia, and Tension-Anxiety) and two positive subscales (Vigor-Activity and Friendship). The total mood disturbance score is calculated by subtracting the Vigor-Activity score from sum of the five negative subscales. The higher the overall mood state score, the stronger the negative mood. Measurements were taken at the earliest time of the week before the program, at the first and last day of the program, and at the latest time of the week after the program (four times in total).

Physical activity

Physical activity was measured using a tri-axial accelerometer (HJA-750C, OMRON HEALTHCARE Co., Ltd.). The tri-axial accelerometer was required to be worn around the waist at all

times from waking to bedtime, except during underwater activities (bathing, swimming, etc.) and sports activities where contact was possible. They were asked to wear it for one week before the program (three days on weekdays), during the program (three to five days on weekdays), and one week after the program (three days on weekdays). The first and last days during the program were excluded from the analysis because they included physical activity associated with movement.

The number of steps and the intensity of physical activity of the subjects were calculated by a previously validated algorithm [16,17]. For the analysis of physical activity, the non-wearing time was defined as "the total time that the activity intensity below the detection threshold and considered as zero count continued for more than 60 minutes" [18]. Zero count was defined as metabolic equivalents (METs) estimated from synthetic acceleration being less than 1. The wearing time was determined by subtracting the non-wearing time from the 24-hour period, and if the wearing time was more than 10 hours per day, the data were accepted [19], and if there was more than one valid day, the data for that individual were accepted. From the data of the participants, the number of steps, sedentary time (<1.6 METs) and sedentary breaks, light intensity physical activity (≥1.6 METs, <3.0 METs), moderate intensity physical activity (≥3.0 METs, <6.0 METs), vigorous intensity physical activity (≥6.0 METs), moderate-to-vigorous intensity physical activity (≥3.0 METs) were calculated. For each physical activity time, the average value per day was calculated. For the data processing of these activity amounts, we used the macro program (ver. 20180919) provided by the Physical Activity Research Platform [20].

Statistical analysis

Measurements before, during, and after the program were presented as means and standard deviations for continuous variables, and as number of observations and percentage (%) for categorical variables. Changes over time from before to after the program were examined by repeated one-way analysis of variance, and the significance of differences between each measurement point was further examined by Bonferroni corrections. All statistical analyses were performed using the open-source statistical analysis environment R (4.0.2 for MacOS), and the statistical significance level was set at 5%.

Table 2. Changes in Blood Pressure, Pulse, and Salivary Amylase Activity Before/After Work

	Pre	During	Post	*P* value
Before the start of work				
SBP, mmHg[a]	122.6±12.9	122.8±11.2	121.7± 11.8	0.6
DBP, mmHg[a]	80.9±10.7	81.8±9.4	81.0±9.2	0.9
Pulse, beat/min[a]	77.6±16.9	74.1±9.1	78.9±10.8[#]	0.6
Salivary amylase activity, kU/L[c]	28.4±19.3	14.5±6.4[*]	24.4±12.4[#]	0.2
After work				
SBP, mmHg[b]	127.2±13.2	126.9±10.6	127.0±11.9	0.9
DBP, mmHg[b]	81.7±11.1	80.1±9.7	83.0±11.2	0.4
Pulse, beat/min[b]	70.6±8.5	77.6±11.7[*]	74.0±11.4	0.1
Salivary amylase activity, kU/L[c]	33.9±24.1	28.3±19.2	28.9±21.0	0.2

Data are expressed as mean ± standard deviation.
Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure.
* Significantly different from pre value (p <0.05); # Significantly different from during value (p <0.05)
a n = 31; b n = 30; c n = 29.

Results

The age of the analysis subjects was 39 ± 9 years old, with seven in their 20s, 10 in their 30s, 14 in their 40s, and six in their 50s or older. Regarding occupations, most of them were in technical and sales positions, and some were designers and managers. The program period (duration of stay in Matsue City) was three days for one company (4 participants), four days for five companies (18 participants), and five days for two companies (15 participants).

Table 2 shows the changes in blood pressure, pulse rate, and salivary amylase activity before and after work time. There was no significant change in systolic or diastolic blood pressure from pre- to post-program either before or after work. Pulse rate increased significantly from the during program to the post-program before the start of work, and significantly from the pre-program to the during program after the end of work. Salivary amylase activity showed a significant temporal change only before the start of work, decreasing from before to during the program and increasing after the program.

Table 3 shows the changes in POMS 2 at pre-, during, and post-program. The scores on all five subscales indicating negative mood decreased significantly from pre-program to during the program. Of these, the "Anger-Hostility" (p = 0.002) and "Confusion-Bewilderment" (p = 0.006) scores increased significantly from the last day of the program to the post-program. On the other hand, the two subscales indicating positive mood both increased significantly on the final day of the program compared to the pre-program ("Vigor-Activity", p = 0.049; "Friendliness", p = 0.009). The total mood disturbance scores decreased significantly from pre-program to during the program (pre vs. first day, p <0.001; pre vs. final day, p <0.001), and increased significantly after the program (p = 0.002). The overall mood state scores in the post-program were significantly lower than the pre-program scores (p = 0.02).

Table 4 shows the changes in physical activity at pre-, during, and post-program. Compared to pre-program, wearing days (p = 0.004), steps (p = 0.01), moderate intensity physical activity (p = 0.002), and moderate to vigorous intensity physical activity (p = 0.005) were significantly decreased, and sedentary breaks (p <0.001) and light intensity physical activity (p <0.001) were significantly increased during the program. Sedentary breaks (p <0.001) and light intensity physical activity (p <0.001) decreased significantly, while moderate intensity physical activity (p = 0.018), and moderate to vigorous intensity physical activity (p = 0.032) significantly increased post-program compared to during the program.

Discussion

In this study, we examined the effects of a short-term telework program in a rural city rich in natural scenery on mood, stress,

Table 3. Changes in Profile of Mood States (n=36)

	Before	During		After	P value
		First day	Final day		
Anger-Hostility, pt	3.3±3.3	0.9±1.5*	0.6±0.9*	1.9±2.6#	<0.001
Confusion-Bewilderment, pt	4.7±3.4	3.2±2.7*	2.4±3.0*	3.9±3.4#	<0.001
Depression-Dejection, pt	3.1±3.8	1.5±2.3*	1.6±2.7	2.2±3.1	<0.001
Fatigue-Inertia, pt	5.6±4.1	3.6±3.4*	3.9±3.8	4.9±4.2	0.003
Tension-Anxiety, pt	6.1±3.9	4.1±3.6*	3.3±3.5*	4.8±4	<0.001
Vigor-Activity, pt	10.1±4.3	10.6±4.8	12.1±4.9*	11.2±4.7	0.001
Friendliness, pt	11.2±4.0	10.8±4.0	12.8±4.1*	11.9±4.5	<0.001
Total Mood Disturbance, pt	12.8±18.3	2.7±12.8*	-0.3 ± 15.0*	6.5±16.7*	<0.001

Data are expressed as mean ± standard deviation.
* Significantly different from before value ($p < 0.05$); # Significantly different from during value ($p < 0.05$)

Table 4. Changes in Physical Activity (n = 25)

	Pre	During	Post	P value
Wearing day, day	2.7±0.5	2.1±0.5*	2.4±0.8	0.08
Wearing time, min/day	877.6±111.3	931.7±76.7	879.0±102.4	0.95
Step count, steps/day	8520±2242	6307±2217*	8043±2582	0.51
Sedentary, min/day	631.7±121.0	599.0±71.7	654.0±116.9	0.33
Sedentary breaks, times/day	61.3±16.5	79.5±14.6*	59.6±14.1#	0.71
LPA, min/day	182.8±63.5	290.4±65.0*	164.2±55.4#	0.44
MPA, min/day	62.9±17.2	41.1±16.6*	60.6±22.1#	0.71
VPA, min/day	0.3±0.4	1.1±3.5	0.2±0.5	0.96
MVPA, min/day	63.2±17.2	42.2±18.4*	60.8±22.2#	0.71

Data are expressed as mean ± standard deviation.
Abbreviations: LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity.

* Significantly different from before value ($p < 0.05$); # Significantly different from during value ($p < 0.05$)

and physical activity in workers from a metropolitan area. The results showed a significant decrease in salivary amylase activity before the start of work, a significant decrease in negative mood and a significant increase in positive mood in the mood profile test during the telework program compared to before the telework. These findings suggest that a telework program in a rural city rich in nature may have a positive impact on the mental health of workers.

There are no previous reports that have examined short-term telework programs, as in this study. There are several studies that have examined the effects of educational training with travel [11] and leisure travel [21,22] on workers' stress and mental health, and their usefulness has been shown. Based on the results of these previous studies, there are two potential reasons for the results of this study: the effects of the natural environment and the effects of business trips (travel). It has been previously reported that exposure to the natural environment can have positive effects such as alleviating stress and fatigue [23]. In the program of this study, the fact that the participants were working in a place where they could see a lake and rice fields, and that they were refreshing themselves in a place where they could experience nature during their free time, may have contributed to stress reduction. In addition, it has been pointed out that environmental changes caused by travel, such as business trips and vacations, bring travelers a sense of psychological liberation [24], which may have also contributed to stress reduction.

In the telework program, salivary amylase activity was significantly lower before the start of work in the objective evaluation index. This could be attributed to the significant reduction in commuting time during the telework program. In metropolitan areas in Japan, congestion and long commuting times place a great burden on body and mind [25]. In this program, the lodging and work locations were extremely close to each other, and the commuting time was almost zero, which may have weakened the stress response, especially before the start of work. However, the results showed that this drastic reduction in commuting time also resulted in decreased physical activity. This decrease in physical activity can lead to metabolic diseases such as obesity and elevated blood glucose levels in the long-term perspective [26]. Therefore, long-term or repeated implementation of such telework programs should include efforts to maintain physical activity levels.

The positive changes in stress control observed from pre-program to during the program were confirmed by the return to pre-program levels in many items after the program. Objective measures such as blood pressure, pulse rate, and salivary amylase activity, as well as the subscales of the mood profile, all showed no significant differences between the pre- and post-program periods, and only the overall mood state, the total score of the mood profile, was significantly lower than the pre-program level, with some rebound. In a previous study, the effects of stress reduction measures (program provision) in the workplace were assessed before and after an extended period of leave, and it was reported that stress may return within a few days to a week after work resumes. In this study, although the content of the program differed between vacation and telework, the results generally supported previous studies in terms of the temporary change of environment during business trips and travels. In addition, it has been pointed out that work stress may be affected by the repetition of leisure time in a short period of time [27], which means that it may be possible to create a lasting effect by providing a program (opportunity) that is repeated several times rather than just once. In this study, only a single session and a one-week follow-up after the program were conducted, so it is necessary to conduct multiple sessions and long-term follow-up to examine better strategies for improving the mental health of workers.

This study examines the effects of a short-term telework program with business travel as a new way of working, and the program itself is novel. Furthermore, the strengths of this study include 1) both of subjective and objective measures were used, 2) a longitudinal study with repeated measurements, and 3) a brief program easy to be implemented and with significant results. However, the study had several limitations. The first is that this was a single-arm study and no comparison with a control group was set. The reason for this is that this study was conducted as a preliminary study and it was difficult to set up a control group that would not be burdensome to the subjects. Therefore, it is impossible to exclude the possibility that the results were due to chance. Second, we did not measure work-related indicators such as workload and work efficiency during the telework program, and it is unclear whether the workers could perform the work required of them or required by the organization during the program period. Considering the relationship between workload and individual stress, it cannot be denied that the decrease in stress confirmed in this study may have been due to a decrease in workload. In the future, it will be necessary to quantify and examine objective and subjective work-related indicators. Finally, there is the issue of bias in the background factors of the subjects. The workers who participated in this study all worked for information and communication technology related companies, and it is possible that they were accustomed to or had a high affinity for telework and were less likely to feel stressed in a work environment different from an office. The external validity of the results of this study is limited because it is likely that familiarity with telework varies greatly by industry. In the future, it will be necessary to examine the results in a wide range of industries and occupations.

Conclusion

In this study, we examined the effects of short-term telework in a local city on stress in workers who live and work in a metropolitan area. It was found that many of the parameters returned to normal after the program, and physical activity during the program decreased. These results suggest that a short-term telework program implemented in a local city may have a positive effect on the mental health of workers.

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