Original Article

Lifestyle change during the COVID-19 pandemic in Japan: implications for continuous positive airway pressure adherence in obstructive sleep apnea patient

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Background: Coronavirus disease 2019 (COVID-19), a global pandemic, has greatly altered our daily lifestyle. Although there have been many reports on the association between COVID-19 and sleep disorders, none have examined this association with continuous positive airway pressure (CPAP) therapy control. Therefore, we aimed to elucidate the impact of lifestyle changes on CPAP users during the COVID-19 pandemic in Japan.

Methods: This study included patients with obstructive sleep apnea (OSA) who were treated with CPAP. We used an original lifestyle questionnaire to collect data on their exercise, amount of food, alcohol consumption, sleep time, and subjective stress. We classified the patients into the following four groups: (I) work from home (WFH); (II) WFH and commuting (hybrid working); (III) commuting; and (IV) unemployed. Downloaded data were used to analyze CPAP adherence. When we compared the physical activity and sleep duration, working respondents were categorized into two groups, namely: (I) the home group, which comprised WFH and hybrid working; and (II) the commuting group without telecommuting at home.

Results: Overall, 663 patients enrolled in this study, and among them, 506 (76.3%) were workers. Additionally, 364 (71.9%) participants changed their work style from commuting due to the COVID-19 pandemic. Physical activity decreased significantly in 60.9% of the participants in the home group ($P<0.01$). The sleep duration increased significantly in 19% of the participants ($P<0.05$). No significant difference was found in Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) score among the groups classified based on work styles. CPAP use significantly shorter in working respondents who were hybrid or commuting workers ($P<0.01$).

Conclusions: The COVID-19 pandemic has resulted in many lifestyle changes. More than 50% of workers who was CPAP user changed their work style, resulting in decreased physical activity, and commuters tended to have shorter durations and lower rates of CPAP use compared to teleworkers.

Keywords: Coronavirus disease 2019 (COVID-19); obstructive sleep apnea (OSA); lifestyle; teleworking; continuous positive airway pressure (CPAP)

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Introduction

Coronavirus disease 2019 (COVID-19), a global pandemic, has greatly altered our daily lifestyle. In Japan, on April 7, 2020, a state of emergency was declared in seven prefectures, including Tokyo, which expanded nationwide on April 16, 2020. During the COVID-19 pandemic, residents refrained from going out, except when necessary for the maintenance of daily life, and cooperated in the prevention of infection. Additionally, the use of facilities where many people gather, such as department stores and movie theaters, was restricted. Regarding the work style, there have been significant changes from what we had before. In Japan, a new style of work was recommended by the Ministry of Health, Labor, and Welfare, such as teleworking, working at home, and practicing staggered commuting. Therefore, working from home has become more prevalent, and people spend more time at home.

It has been reported that there is a significant association between major stressful events, COVID-19 and insomnia (1). Similarly, a relationship has been reported between COVID-19 and sleep disorders. A new term, "coronasomnia", has been proposed to include the sleep disorders caused by the COVID-19 virus (2). Many previous studies have reported that anxiety, depression, and post-traumatic stress disorder have a significant impact on people's sleep disorders (3,4). It has been reported that there is an increased awareness of a decline in sleep quality after the implementation of a lockdown in China and other countries, such as Germany and France (5,6). However, it has been considered that total sleep duration has increased mildly (5,7). Moreover, it has been reported that increased overeating and alcohol consumption and decreased opportunities for exercise due to lockdowns may impact lifestyle-related diseases (2).

Obstructive sleep apnea (OSA) is the most common upper airway breathing disorder characterized by repetitive collapse of the pharyngeal airway during sleep, leading to sleep fragmentation and oxygen desaturation (8). The apneic episodes in OSA induce an increase in blood pressure and cardiovascular and cerebrovascular risk (9). Regarding OSA management, continuous positive airway pressure (CPAP) therapy is a first-line treatment for moderate to severe OSA, which improves psychological and physical impairments in patients with sleepiness, fatigue, neurocognitive impairment, and depression (10). Additionally, it can prevent hypertension, adverse cardiovascular events, and arrhythmia (11). The prevalence of OSA is increasing globally and is estimated to be approximately 10% of the population (12). Although no difference is found in the rate of infection with COVID-19 in patients with OSA compared to those without OSA, there is a higher risk of severe complications. While there have been many reports on the association between COVID-19 and sleep disorders, none have examined this association with CPAP therapy control.

In a Japanese study, Suka *et al.* conducted a web-based survey in November 2020, approximately 9 months after the COVID-19 pandemic began in Japan. They reported deteriorating health status of the people, weight gain, and increased sleeping times (13). Hori *et al.* compared the sleep duration of Japanese university students before and after the COVID-19 pandemic and reported that they slept significantly longer on weekdays after the pandemic (14).

Highlight box

Key findings

- This study revealed that >70% of workers with continuous positive airway pressure (CPAP) using changed their work style to telecommuting, resulting in decreased physical activity, and commuters tended to have shorter durations and lower rates of CPAP use compared to teleworkers.

What is known and what is new?

- The coronavirus disease 2019 pandemic has resulted in many lifestyle changes. However, no studies have reported how these factors affect obstructive sleep apnea patients undergoing CPAP treatment.
- Our study investigated the impact of lifestyle changes on CPAP users during Japan's first state of emergency. Over 50% of CPAP users who were employed changed their work style, leading to reduced physical activity. Commuters showed shorter durations and lower adherence to CPAP therapy compared to teleworkers.

What is the implication, and what should change now?

- We provided important data on lifestyle changes during the coronary pandemic period for CPAP users. Further randomized controlled studies are needed to confirm these findings.

Most research to date has focused on general sleep quality during the pandemic, without considering the specific needs and behaviors of CPAP users who require consistent adherence to maintain therapeutic efficacy. Therefore, this study aimed to elucidate the impact of workstyle and lifestyle changes such as subjective stress, sleep duration time, exercise using a questionnaire on CPAP users during the first state of emergency for the COVID-19 pandemic in Japan in April 2020. In addition, we investigated how lifestyle changes affected CPAP adherence. This study is the first to examine how the shift to remote work, hybrid work arrangements, and other pandemic-induced lifestyle changes directly impacted CPAP adherence in a large cohort of OSA patients in Japan. By addressing this gap, this study provides new insights into the unique challenges faced by CPAP users during the pandemic and provides valuable data on how work style transitions and lifestyle changes impact long-term disease management. This new perspective underscores the importance of considering external environmental and occupational factors when assessing CPAP adherence, especially in the context of a global health crisis. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1194/rc).

Methods

Materials

Overall, 666 patients with OSA who were treated with CPAP were enrolled in this study. All patients continued CPAP treatment at the Sleep and Sleep-Disordered Breathing Center of Juntendo University Hospital between April 2020 and May 2020, during the first state of emergency. The exclusion criteria were as follows: (I) age <20 years; (II) treatment for sleep-disordered breathing, including the use of oral appliances and upper airway surgery during the study; (III) pollen nasal allergy; (IV) primary insomnia and other sleep disorders; and (V) inability to answer questions due to cognitive impairment. Questionnaires were collected at the first outpatient visit after the state of emergency. We used an original lifestyle questionnaire (Figure S1). Our questionnaire was performed during the first outpatient visit, which occurred between April and May 2020, 30–60 days after the state of emergency was declared. Regarding the "changes in working style", we classified the patients into the following four groups: (I) work from home (WFH); (II) WFH and commuting (hybrid working); (III) commuting; and (IV) unemployed. For "changes in lifestyle", the items of exercise, amount of food, alcohol consumption, sleep time, and subjective stress were evaluated on a three-point scale—decreased, unchanged, and increased. The Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) questionnaire was used to evaluate the subjective symptoms. The PSQI-J is a self-administered questionnaire widely used to evaluate sleep quality. It has the following seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Scores of ≥6 are rated as bad sleep habits and are a useful, standardized measure for comparison between individuals (15,16). To analyze CPAP adherence, downloaded data between April and May 2020 were used, and the average CPAP usage time, the CPAP usage rate, and the CPAP usage rate of more than 4 h were compared.

This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approved by the Ethics Committee of Juntendo University Faculty of Medicine (#E22-0087). All patients provided informed consent.

Statistical analysis

Statistical analyses were performed to compare the changes in work style with lifestyle and CPAP data. GraphPad Prism8 software (GraphPad Software, San Diego, CA, USA) and StatMate V software (ATMS Co., Ltd., Chiba, Japan) were used for this study. The Chi-squared and Fisher's exact tests were used to compare categorical data, and the Mann-Whitney *U* and Kruskal-Wallis tests were used for sequential data. When significant differences were found, multiple comparison tests were performed using the Bonferroni method and post hoc comparisons were made. Statistical significance was set at $P<0.05$.

Results

Changes in work style during a state of emergency

A total of 666 patients responded to the survey. Of these, three individuals were excluded from the analysis as they were under 20 years of age. Finally, 663 people were surveyed. Regarding changes in work style, 121 (18.3%) patients answered "commuting", 207 (31.2%) were "hybrid working", 178 (26.8%) were "fully WFH",

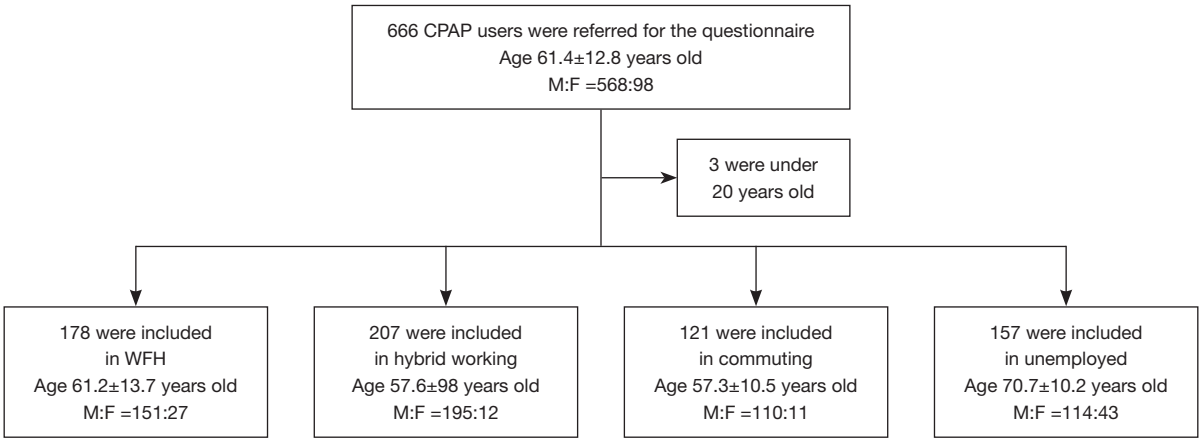

Figure 1 Flow chart of the patient enrollment. Patients were divided into four groups, commuting, hybrid working, WFH, and unemployed, according to working style. Three were excluded because they were under 20 years old. The unemployed group had a larger number of individuals aged 65 years and older. CPAP, continuous positive airway pressure; F, female; M, male; WFH, working from home.

and 157 (23.7%) participants were "unemployed". As for workers, 506 (76.3%) of all responders were evaluated. Twenty-one (4.2%) of the workers had originally been in a telecommuting configuration before the COVID-19 pandemic. "Telecommuting" means only WFH, such as online meeting, desk work, self-employment, etc. Furthermore, 364 (71.9%) of hybrid or fully WFH people changed their work style from commuting due to the COVID-19 pandemic (*Figure 1*). The age profile of each group showed that the unemployed group had a larger number of individuals aged ≥65 years.

Lifestyle changes during the state of emergency

Regarding lifestyle changes, 58.3%, 73.8%, 57.3%, and 75.7% responded "no change" for "subjective stress", "sleep duration", "alcohol consumption", and "amount of food eaten", respectively. These accounted for more than half of the population. Regarding exercise, "unchanged" and "decreased" accounted for 41.5% and 50.7%, respectively (*Figure 2A*).

Working respondents were categorized into two groups, namely: (I) the home group, which comprised WFH and hybrid working; and (II) the commuting group without telecommuting at home. The physical activity decreased significantly in 60.9% of the home group (P<0.01) (*Figure 2B*). Additionally, the sleep duration increased significantly in 19% of the participants in the home group (P<0.05) (*Figure 2C*).

Differences between work style and evaluation of subjective sleep quality (PSQI-J)

The PSQI-J score was compared among the following four groups: commuting, hybrid working, WFH, and unemployed groups. No significant difference was found in the PSQI-J score (*Figure 3*). Additionally, no significant differences were observed regarding subjective "sleep quality", "sleep duration", and other components.

Work style and CPAP adherence

CPAP adherence was compared among the four groups. In all groups, the average rate of CPAP use was >4 h. CPAP using time significantly shorter in working respondents who were hybrid or commuting workers (*Figure 4A*, P<0.01). This was also true for the rate of CPAP use for at least 4 h per night (*Figure 4B*, P<0.05). Both of them were significant difference by multiple comparison tests (P<0.01).

Discussion

In this study, we used an original questionnaire to examine the impact of CPAP treatment on changes in people's lives during a state of emergency declared following the spread of the new coronavirus infection in Japan. We found that 71.9% of workers changed their work style to telecommuting. The declaration of a state of emergency did not affect sleep duration, alcohol consumption, or

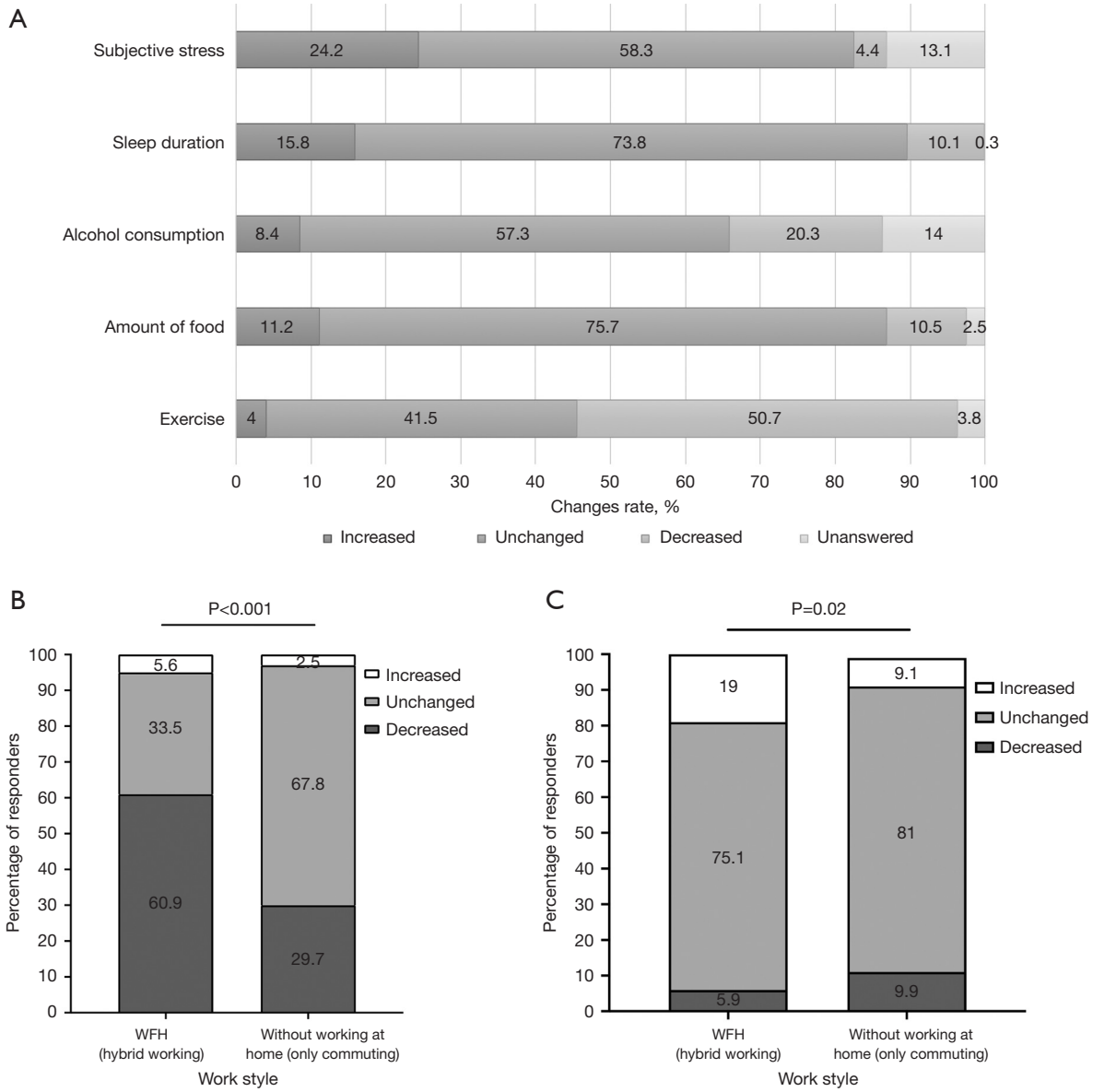

Figure 2 Lifestyle changes during the state of emergency. (A) Lifestyle changes during emergencies for all respondents. 58.3%, 73.8%, 57.3%, and 75.7% of all respondents answered that they had not changed their subjective stress, sleep duration, alcohol consumption, or amount of food. Regarding exercise, 50.7% of respondents answered "decreased". (B) Comparison of physical activity among workers with and without telecommuting. The physical activity decreased significantly in 60.9% of the home group (P<0.001). (C) Comparison of sleep duration among workers with and without telecommuting. The sleep duration increased significantly in 19% of people in the home group (P=0.02). WFH, work from home.

subjective stress; however, 50.8% of respondents reported a decrease in physical activity. Commuters tended to have shorter durations and lower rates of CPAP use compared to teleworkers. Moreover, this study indicated that teleworking significantly increased sleep duration and CPAP use but also decreased exercise habits.

Several studies have reported an association between OSA and COVID-19. Although no difference is found in the rate of infection with COVID-19 in patients with OSA compared to those without OSA, the risk of severe COVID-19 infection is 2.93 times higher (17). Another study reported that COVID-19 infection in

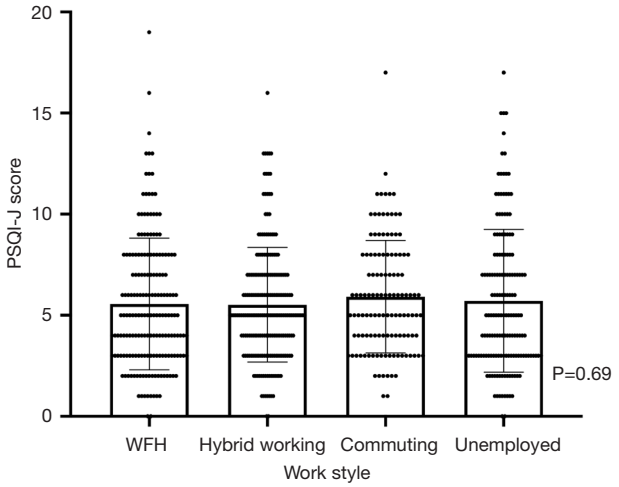

Figure 3 Differences between work style and evaluation of subjective sleep quality (PSQI-J). PSQI-J score was compared among the four groups, but there was no significant difference in PSQI-J score (P=0.69). PSQI-J, Japanese version of the Pittsburgh Sleep Quality Index; WFH, working from home.

patients with OSA is a risk factor for the frequency of intensive care unit admission, need for ventilator use, and death (18). Originally, the risks for severe COVID-19 infection included older age, male sex, obesity, diabetes, cardiovascular disease, and poor pulmonary function, and it is believed that this is because patients with OSA are more likely to have these diseases as complications of their disease (19). Additionally, several common mechanisms have been reported in the pathogenesis between OSA and COVID-19 infections, such as elevated interleukin, tumor necrosis factor, and cytokine levels (20). Some patients in our study group had COVID-19 infection; however, they were mild cases that recovered naturally with home care. CPAP therapy, which is considered the most effective treatment for OSA (21,22), is also important for respiratory management during COVID-19 (23,24). Because patients with OSA originally have poorer ventilation during sleep than healthy individuals, the initial use of CPAP for COVID-19 infection is beneficial for hypoxia (25).

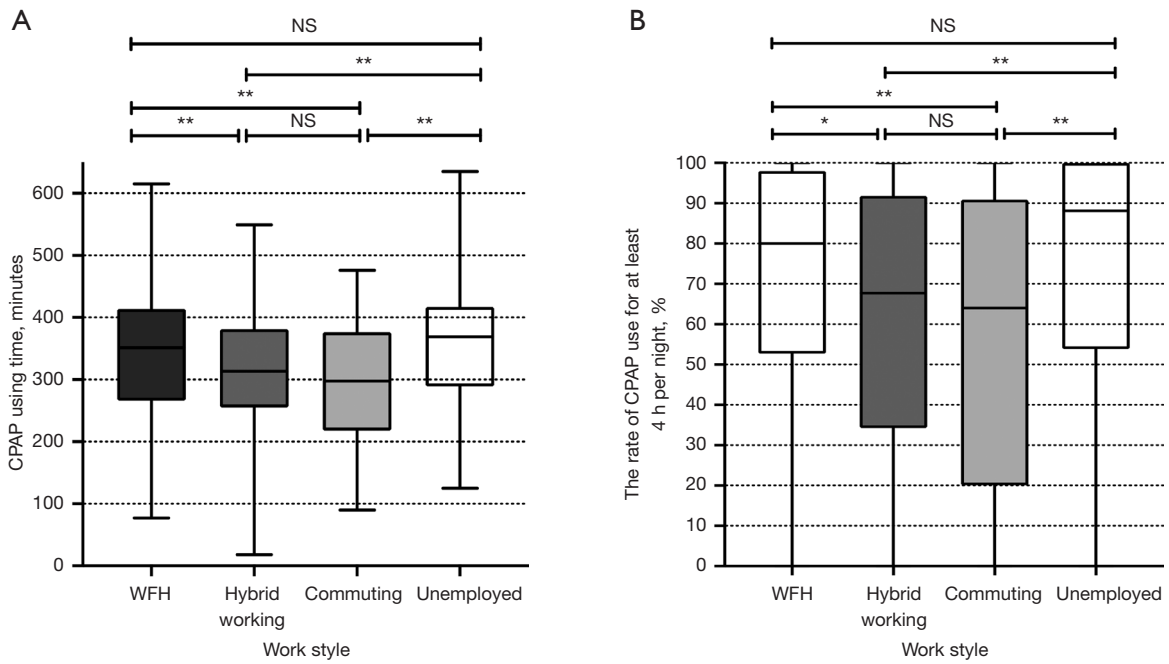

Figure 4 Work style and CPAP adherence. (A) CPAP adherence were compared among the four groups. CPAP using time significantly shorter in working respondents who are hybrid or commuting worker (P<0.001). (B) The rate of CPAP use for at least 4 h per night was lower (P<0.001). P values are indicated by stars: *, P<0.05; **, P<0.01; NS, no significance (P>0.05). CPAP, continuous positive airway pressure; WFH, working from home.

Generally, factors that affect the exercise habits of people in their lifestyles include busyness, chronic diseases (especially orthopedic diseases), psychological problems, and financial problems (26). In our study regarding the COVID-19 pandemic, 50.8% of people answered that their exercise habits have decreased during the state of emergency. Although objective workloads were not assessed in this study, the busyness of workers may not have changed significantly because they worked at home, such as in online meetings. Additionally, social factors, such as the restriction of jogging/walking due to a lifestyle of refraining from going out and refraining from operating public facilities, such as sports gyms, were also thought to be factors.

Regarding sleep duration, Japanese people are considered to be one of the world's shortest sleepers. Compared with other countries, it is the worst in many reports. The average duration of sleep among Japanese people is approximately 6 h, which is 1 h less than that in other countries (27). There are some differences in sleep between countries. Several reports showed that Asians sleep less than Europeans and Americans. With the declaration of a state of emergency, people are sleeping longer because they spend more time at home and change their work styles. Although still not as long as the average sleep duration in other countries worldwide, increasing sleep duration has been reported to improve brain activity, emotional control, blood pressure control, blood glucose levels, and exercise function (28). It is considered to have many physical and mental benefits. For patients with OSA, the duration of good sleep associated with CPAP is expected to have a significant benefit. The PSQI is frequently used to assess sleep disorders. In this study, we calculated the scores using the PSQI-J. Contrary to our expectations, lifestyle changes and living during the COVID-19 pandemic did not significantly affect the PSQI-J score in the "subjective sleep quality" component, despite a stressful life with the emergence of the new coronavirus.

Our data also showed that changes in work style significantly affected the rate of CPAP use and use for >4 h. The long-term use of CPAP has been reported to have various benefits for patients with untreated OSA. Overnight use for >4 h is considered to reduce the risk of cardiovascular events (hypertension, heart failure, and arrhythmias, among others) (29), and further prolonged use has been reported to be effective in improving daytime somnolence, cognitive function, and mortality (30). It is an important indicator for assessing compliance with CPAP therapy for OSA. As telecommuting became more popular, the frequency of commuting to work decreased. It was possible that this increased the overall amount of sleep as well as the opportunity to use CPAP, which is associated with good adherence.

This study had some limitations. First, the survey comprised CPAP users, which potentially limits the generalizability of our results to other populations. It also did not evaluate each patient with regards to the severity of pre-treatment OSA. It has been reported that severity of OSA affects CPAP adherenece (31). Moreover, this study included participants with co-morbid insomnia (both OSA and insomnia), which may have introduced additional variability into the results. Second, the survey was conducted during the first emergency declaration. Some patients could not be seen due to concerns about the risk of COVID-19 infection, and it was impossible to survey all CPAP users. Third, the survey was conducted by our original questionnaire, first used during the first declaration of the state of emergency when people were still trembling with fear over coronavirus, and people refrained from going out and spent much of their time at home. Five states of emergency were issued after our survey, and people had adapted to a new lifestyle. Further investigation is required from recent years when people have become accustomed to the global situation of the coronavirus. Finally, the amount of exercise was evaluated subjectively; however, future research should quantitatively survey exercise, such as the kind of exercise, how long, and how many calories were burned.

Conclusions

The COVID-19 pandemic has resulted in many lifestyle changes. However, no studies have reported how these factors affect patients undergoing OSA treatment. Our report examined the impact of lifestyle changes on CPAP users during the first state of emergency in Japan. This study revealed that >70% of workers changed their work style to telecommuting, resulting in decreased physical activity, and commuters tended to have shorter durations and lower rates of CPAP use compared to teleworkers. Currently, during the post-coronavirus pandemic period, people's lives have changed. Society should adapt to not only the infectious aspect of the disease but also sleep, physical, and mental health.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1194/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1194/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1194/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Juntendo University Faculty of Medicine (#E22-0087) and informed consent was obtained from all individual participants.

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