A longitudinal survey of the effects of the Novel Coronavirus on exercise and sports among university students in Japan belonging to the Physical Education Faculty

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Abstract

Problem statement: The novel coronavirus (COVID-19) has changed global engagement with sports and physical activity and caused significant changes in exercise and sports practices due to reduced interpersonal contact and closure of sports facilities. **Purpose:** This study investigates how the physical activity, exercise, and lifestyles of Japanese physical education students, deeply involved in sports, changed due to the school closures and curfews associated with COVID-19. **Methods:** The sample consisted of 74 Japanese male and female students. Changes in sleep duration, self-assessed subjective exercise intensity, and fatigue levels were assessed by dividing the study period into three phases: April to June 2020 (participants voluntarily restricted their movements), July to September 2020 (return to normal activity levels), and October to December 2020 (three months following the initial return to normal activity levels). Participants used Google Forms to record their sleeping hours, perceived exertion rating, and fatigue daily during the study period, and the results were compared to those obtained via a questionnaire that they completed assessing these variables during the same period of the previous year. **Results:** We found that school closures caused: 1) a decrease in opportunities to engage in exercise such as club activities, which resulted in a reduction in the amount of physical activity performed owing to the difficulty of performing light exercise at home, and 2) a significant change in lifestyle habits such as an increase in time spent asleep and a decrease in the level of fatigue. **Conclusions:** Overall, school closures reduced opportunities for exercise and physical activity and led to significant changes in lifestyle habits among physical education students. Attempts should be made to provide opportunities for exercise and to discover ways to provide exercise-related instruction while ensuring that the spread of infection is curbed.

Key Words: physical education students, COVID-19, sleep duration, subjective exercise intensity, voluntary movement restriction, subjective fatigue level

Introduction

COVID-19 has spread worldwide since the mass infection was first reported in Wuhan City, Hubei Province, China, at the end of 2019. By the end of June 2020, the cumulative number of people who had been infected exceeded 10 million (EduHack, 2021; Grix, Brannagan, Grimes & Neville, 2021; Johns Hopkins University, 2020; UNESCO, 2021). COVID-19 has had a significant impact on the home and work environments, and people's social lives (Bender, 2020; Dhawan, 2020). In Japan, due to the emergence of COVID-19 during the period when people were asked to limit their movements from April to June, universities forced their students to refrain from any face-to-face activities at university. However, from July to September 2020, some face-to-face activities and athletic clubs resumed their activities, which increased the amount of time that students spent on commuting and schoolwork (Sasakawa Sports Foundation, 2020). In addition, restrictions on sports, cultural and musical events, travel, and social interaction are considered to have significantly reduced opportunities for active rest, which is the key to stress management (McCloskey, et al., 2020; Parnell, Widdop, Bond & Wilson, 2020).

Some surveys have described increasing anxiety among individuals about viruses. According to the Survey Research Center (2020) and Jungmann (2020), public anxiety surrounding the virus is increasing. Rajkumar (2020) and Torales et al. (2020) have reported anxiety associated with the spread of COVID-19 and its impact on mental health due to restrictions on daily life during the lockdown. Miyagi (2009) cited that changes in the home and work environment and the social life of individuals are factors contributing to environmental stress in modern society. However, in England, the highest levels of depression and anxiety occurred during the early stages of lockdown but declined rapidly, possibly because individuals adapted to the circumstances (Fancourt et al., 2021). In India, the present lockdown affects people differently with regard to their sex,

profession, socioeconomic status, or location (Rehman et al., 2020). Additionally, according to Santabarbara et al. (2021), as the overall global prevalence of anxiety disorders is estimated to be 7.3%, the rate of anxiety in the general population could be more than three times higher during the COVID-19 pandemic. These findings suggest a substantial impact on mental health that should be targeted by individual and population-level strategies (Santabarbara et al., 2021).

Eminently, the spread of COVID-19 has deprived people of opportunities to engage in sports (Adedoyin & Soykan, 2020; Ferdig, Baumgartner, Hartshorne, Kaplan-Rakowski & Mouza, 2020; Filiz & Konukman, 2020; Shape America, 2020). As a result, the amount of physical activity and exercise among the population has declined greatly in efforts to reduce interpersonal contact to contain the infection. Consequently, significant changes in lifestyle and habits are expected to occur (Iowa Department of Education, 2020; Jones, 2020; Lau & Lee, 2020; Yomoda & Nagoya Gakuin University Faculty of Health and Sports, 2020).

Against this backdrop, the Sasakawa Sports Foundation, which promotes the idea of “Sports for Everyone,” conducted a nationwide survey in Japan on the impact of COVID-19 on exercise and sports in June 2020, targeting 5,000 men and women aged 18–79 (2020). In this study, they investigate how the physical activity, exercise, and lifestyles of physical education students, who are usually deeply involved in sports, changed in an environment where restrictions were placed on their lives due to COVID-19. First, respondents were asked whether they could participate in all the sports or physical activities they had been engaged in since February 2019 with the spread of COVID-19. The results showed that 56.0% of respondents reported being unable to practice at least one of the sports they had done previously, and this accounted for the majority of those who practiced sports. In brief, the top ten sports activities affected were primarily those performed at private and public sports facilities, reflecting the influence of facility closures due to the spread of the virus. Second, the respondents were asked if they would be more careful about when exercising or playing sports in the future. The results showed that 67.5% of respondents wanted to be careful about infecting COVID-19. This suggests that the need for exercises and sports that can be practiced at home or in one’s local area will increase in the future.

The afore-mentioned is the general situation surrounding the COVID-19 epidemic in the Japanese population. The amount of physical activity among university students, whose mobility and exercise in daily life is assumed to have been severely restricted during this period, has decreased significantly. Therefore, there is a possibility that not only physical fitness but also mental and physical health, may be adversely affected.

This study aims to clarify changes in sleep duration, self-assessed subjective exercise intensity, and fatigue levels.

Material & methods

The study period was divided into three phases: April to June 2020 (participants voluntarily restricted their movements), July to September 2020 (return to normal activity levels), and October to December 2020 (three months following the initial return to normal activity levels). Participants used Google Forms to record their inputs. The results were obtained via a questionnaire that they completed assessing these variables during the same period of the previous year.

Participants

A total of 74 participants completed the survey. Of the total participants, 38 were male, and 36 were female. The mean age of the participants was 20 years during the commencement of the study on the 1st of April 2020. In addition, all participants were students belonging to the Athletic Department of the Department of Sports Science in the Faculty of Education at the University of Japan. The study protocol was approved by the Osaka Kyoiku University ethics committee (Chairperson: Masanao Katagiri; Approval number: 20021), and written consent was obtained before commencing the study. The procedures were conducted according to the principles of the Declaration of Helsinki.

Procedures and instruments

The study duration was from April 1 to December 31, 2020 (April to June was the first national lockdown in Japan). A Google form was created and circulated on different online platforms such as *WhatsApp* groups and *LinkedIn*. From April through December 2019, the participants were asked to complete the questionnaire and submit the data using Google Form. The content of the study was explained to the subjects, and their consent to participate was obtained. The content involved participants recording their “Sleeping hours,” “Rating of Perceived Exertion (RPE),” and “Fatigue” through Google Form every day during the study period. The internal reliability of the three scales in the questionnaire was indicated by a value of Cronbach’s alpha coefficient of 0.83.

Data collection and analysis/statistical analysis

The average sleeping hours for RPE and Fatigue were calculated for each respondent during the three phases of the study period. The responses to the questionnaire survey concerned the period from April to December 2019, the period before people were asked to voluntarily restrict their movements. Subjective perspectives on exercise intensity were evaluated and recorded on a 17-point scale from “0” to “16.” The larger the number, the greater the burden felt. The mean of subjective exercise intensity was calculated for each respondent over the three phases of the study period. The questionnaire responses were used from April to December 2020, when people were asked to voluntarily restrict their movements.

The degree of subjective fatigue experienced was recorded through self-evaluation by the participants using a scale of 1–10, where the larger the number, the greater the degree of physical fatigue. The average subjective fatigue level of each participant was calculated from responses for each of the three phases of the study, along with the period before people were asked to voluntarily restrict their movements.

Changes in sleep hours, self-assessed subjective exercise intensity, and levels of fatigue due to COVID-19 were compared between 2019 and 2020. In addition, each change in 2020 explained above was compared among the three periods. Data were analyzed using SPSS v 21. The Wilcoxon signed-rank test with a Bonferroni correction was carried out to make inferences.

Results

Figure 1 shows the average sleep duration from April to June 2020, during the period when people were asked to voluntarily restrict their movements, and from July to September and October to December 2020, after the restriction period. The average sleep duration from April to June 2020 was 6 h 58 min; from July to September 2020 was 6 h 33 min, and from October to December 2020 was 6 h 28 min. As a result, significant differences were observed using the Friedman test ($p < 0.01$). In addition, significant differences among all three periods were obtained by the Wilcoxon signed ranked test with a Bonferroni correction to determine which period had a significant difference ($p < 0.05$).

Fig. 1 Sleeping hours (2020/04–12)

Fig. 2 shows the average sleep duration between April and June 2019, before the period when people were asked to restrict their movements, and between April and June 2020, during the period when people were asked to restrict their movements. The average sleep duration from April to June 2019 was 6 h 19 min, whereas that from April to June 2020 was 6 h 58 min. A significant difference between the two periods was observed by the Wilcoxon signed-rank test ($p < 0.01$). Collectively, 8.1% of the participants slept 9 hours or more, 21.6% slept 8 hours or more, and 37.8% slept 7 hours or more. These percentages were higher than those from April to June 2019, before people were asked to restrict their movements. Contrarily, 29.7% of the respondents slept 6 hours or more, 18.9% slept 5 hours or more, and 5.4% slept 4 hours or more during the period from April to June 2019 before they were asked to restrict their movements, which is higher than the period from April to June 2020.

Fig. 2 Sleeping hours (2019/04–06, 2020/04–06)

Figure 21-2 Sleeping hours (2019/04–06, 2020/04–06)

Fig. 3 shows the average sleep duration before and after the period when people were asked to restrict their movements, from July to September 2019 and from July to September 2020. The average sleep duration from July to September 2019 was 6 h 19 min, while that from July to September 2020 was 6 h 33 min. A significant difference between the two periods was indicated by the Wilcoxon signed-rank test ($p < 0.01$). The average sleep duration from July to September 2020 after people were asked to voluntarily restrict their movements was that 86.5% said “7 hours or more” or “6 hours or more,” which was 21.7% higher than similar figures from July to September 2019, before people were asked to restrict their movements. From July to September 2020, the number of participants who slept for extremely long or short periods was smaller than that in the same period from 2019.

It is possible that the effect of COVID-19 caused a change in lifestyle, which in turn caused changes in the sleep duration.

Fig. 3 Sleeping hours (2019/07-09, 2020/07-09)

Fig. 4 shows the average sleep duration before and after the period when people were asked to voluntarily restrict their movements (October to December 2019 and the same period in 2020). The average sleep duration from October to December 2019 was 6 h 15 min, while that from October to December 2020 was 6 h 28 min. A significant difference between the two periods was indicated by the Wilcoxon signed-rank test ($p < 0.01$). Regarding the average sleep duration in October–December 2020, after the period when people had been asked to limit their movements, 45.9% reported they slept “7 hours or more,” and 8.1% said “8 hours or more,” which was higher than in October–December 2019, before people were asked to limit their movements. On the other hand, 4.1% of respondents slept less than 5 hours, 16.2% slept 5 hours or more, and 37.8% slept 6 hours or more from October to December 2019, before the period when people had been asked to limit their movements. These figures were all higher than the corresponding ones in October to December 2020 period.

Fig. 4 Sleeping hours (2019/10-12, 2020/10-12)

Fig. 5 shows the average exercise intensity from April to June 2020 during the period when people were asked to voluntarily restrict their movements, and from July to September 2020 and October to December 2020, after the period when people were asked to voluntarily restrict their movements. The average exercise intensity from April to June 2020 was 6.5 ± 0.25 . The average exercise intensity from July to September 2020 was 7.6 ± 0.28 , while that from October to December 2020 was 9.1 ± 0.37 . Significant differences were observed under the Friedman test ($p < 0.01$). In addition, significant differences among the three periods were found under the Wilcoxon signed ranked test with Bonferroni correction when determining which periods showed significant differences ($p < 0.05$). Specifically, the average subjective exercise intensity during April to June 2020, when people were asked to voluntarily restrict their movements, was the same as or higher than the period July to September 2020 and October to December 2020 after the same period, when it was “6” or lower. On the other hand, the responses regarding the average subjective exercise intensity from July to September 2020, after people were asked to voluntarily restrict their movements, were 18.9% for “7,” 16.2% for “8,” and 18.9% for “9,” which were higher than responses for the timeframe of between April and June 2020, when people were asked to voluntarily restrain their movements. The mean subjective exercise intensity from October to December 2020 after the period when people were asked to voluntarily restrict their movements was the same as or higher than that in the period from April to June 2020, when people were asked to voluntarily restrict their movements, and the period from July to September 2020 after this period for scores of “10” and higher. In addition, the high intensity selections of “15” and “16” were only found in the period from October to December 2020, following the period when people were asked to voluntarily restrict their movements.

Fig. 5 RPE (2020/04–12)

Fig. 6 shows the average subjective exercise intensity from April to June 2019, before people were asked to voluntarily restrict their movements, and from April to June 2020. The average subjective exercise intensity from April to June 2019 was 9.4 ± 0.37 , and the average subjective exercise intensity from April to June 2020 was 6.50 ± 0.25 . Significant differences between the two periods were shown by the Wilcoxon signed-rank test ($p < 0.01$). The proportions of “12,” “13,” and “14” responses given, which indicate high intensity, were high in the period from April to June 2019, before people were asked to voluntarily restrict their movements. The proportions of “2,” “3,” “4,” “5,” and “6” responses, indicating low intensity, were high in the period from April to June 2020, when people were asked to voluntarily restrict their movements.

Fig. 6 RPE (2019/04–06, 2020/04–06)

Fig. 7 shows the mean subjective exercise intensity from July to September 2019 and from July to September 2020. The average subjective exercise intensity from July to September 2019 was 10.9 ± 0.36 , while that from July to September 2020 was 7.6 ± 0.29 . Significant differences between the two periods were obtained using the Wilcoxon signed-rank test ($p < 0.01$). The mean subjective exercise intensity of responses “10” or higher was higher in the period from July to September 2019 than from July to September 2020. On the other hand, for responses with an average subjective exercise intensity of “9” or less, the percentage was higher in the period from July to September 2020 than from July to September 2019.

Fig. 7 RPE (2019/07-09, 2020/07-09)

Fig. 8 shows the average subjective exercise intensity from October to December 2019 and from October to December 2020. The average subjective exercise intensity from October to December 2019 was 9.8 ± 0.34 , while that from October to December 2020 was 9.1 ± 0.37 . Significant differences between the two periods were shown by the Wilcoxon signed-rank test ($p < 0.01$). The mean subjective exercise intensity of responses 12 and above showed a high result of “15” in the period from October to December 2020; however, in the period from October to December 2019, the number of responses of “12,” “13,” “14,” and “16” was higher. In contrast, the proportion of those responding with a “3,” “4,” “5,” or “6,” which signals low intensity, was the same or higher in the period from October to December 2020 than from October to December 2019.

Fig. 8 RPE (2019/10-12, 2020/10-12)

Fig. 9 shows the average subjective fatigue levels from April to June 2020 and from July to September 2020, as well as from October to December 2020. The average subjective fatigue level from April to June 2020 was 5.0 ± 0.17 , while that from July to September 2020 was 5.7 ± 0.17 . The average subjective fatigue level from October to December 2020 was 5.9 ± 0.20 , and significant differences were found using the Friedman test ($p < 0.01$). In addition, significant differences among all three periods were found by the Wilcoxon signed-rank test with Bonferroni correction ($p < 0.05$). The mean subjective fatigue levels from April to June 2020 were 5.4% for “2,” 8.1% for “3,” and 27.0% for “4,” which were all higher than those during July to September 2020 and October to December 2020. Scores for the average subjective level of fatigue from July to September 2020 were “7” (18.9%) and “8” (13.5%), which were higher than the same scores in the period from April to June 2020. Moreover, from October to December 2020, the mean subjective fatigue of “8” was lower than that of the period from July to September 2020, but the mean subjective fatigue responses of “6,” “7,” “9,” and “10” were the same or higher than those in the periods from April to June 2020 and from July to September 2020.

Fig. 9 Fatigue (2020/04–12)

Fig. 10 shows the average subjective level of fatigue from April to June 2019 and from April to June 2020. The average subjective level of fatigue from April to June 2019 was 5.8 ± 0.27 , while that from April to June 2020 was 5.0 ± 0.17 . Significant differences between the two periods were indicated by the Wilcoxon signed-rank test ($p < 0.01$). In the period from April to June 2019, the mean subjective fatigue level was the highest at “8” (21.6%). On the other hand, during the period from April to June 2020, the most common response regarding the mean subjective fatigue level was “4” (27.0%), followed by “5” (24.3%).

Fig. 10 Fatigue (2019/04–06, 2020/04–06)

Fig. 11 shows the average subjective fatigue levels from July to September 2019 and from July to September 2020. The average subjective level of fatigue from July to September 2019 was 10.9 ± 0.36 , while that from July to September 2020 was 7.6 ± 0.29 . Significant differences between the two periods were shown by the Wilcoxon signed-rank test ($p < 0.01$). The mean subjective fatigue levels in the period from July to September 2019 were 10 (8.1%), 9 (18.9%), and 8 (16.2%), respectively, which were higher than in July–September 2020. On the other hand, the average subjective fatigue levels from July to September 2020 were 4 (21.6%) 5, (24.3%), 6 (18.9%), and 7 (18.9%), which were higher than those in July–September 2019.

Fig. 11 Fatigue (2019/07–09, 2020/07–09)

Fig. 12 shows the mean subjective fatigue levels from October to December 2019 and from October to December 2020. The average subjective level of fatigue from October to December 2019 was 9.8 ± 0.34 , while that from October to December 2020 was 9.1 ± 0.37 . Significant differences between the two periods were obtained using the Wilcoxon signed-rank test ($p < 0.01$). There was no significant difference between the two periods for the responses of “9” and “10,” which indicate high mean subjective fatigue, but 27.0% and 17.6% of the respondents answered “7” and “8” from October to December 2019, and 18.9% and 6.8% in October–December 2020, suggesting that the number of respondents reporting these numbers was higher in the period from October to December 2019. On the other hand, regarding the mean subjective fatigue levels from October to December 2020, 6.8% answered “3,” 13.5% answered “4,” 14.9% answered “5,” and 29.7% answered “6,” more than from October to December 2019.

Fig. 12 Fatigue (2019/10–12, 2020/10–12)

Discussion

The average sleep duration in this period decreased in comparison to the periods from April to June 2020 and from July to September 2020. In addition, in the period from October to December 2020, the average sleep duration may have decreased even more than in the period from July to September 2020 because people became accustomed to the new lifestyle caused by the virus and spent more time on schoolwork and sports club activities.

It may be considered that because of COVID-19, the activities of the athletic clubs were restricted, and online classes were introduced, with part of the time that had been used for commuting and schoolwork replaced by time spent sleeping. In addition, it is noted that the average sleep time increased from April to June 2020, compared to April to June 2019. Furthermore, it was noted that even when more than three months had passed since the end of the period when students were asked to restrict their movement, lifestyle changes due to the effects of COVID-19 had not returned to normal. This might have affected the hours of sleep. However, according to the result, students are gradually returning to their average time spent sleeping in the last year.

The mean subjective exercise intensity was higher in the period from July to September 2020 than April to June 2020, when activities at sports clubs were restricted because of COVID-19, and even higher in the period from October to December 2020, when activities increased. However, the results for the period from October to December 2020, after the period when people were asked to voluntarily restrict their movements, were higher than those for the period from July to September 2020 but slightly lower than those for the period from April to December 2019. This suggests that the impact of COVID-19 has affected students belonging to athletic clubs over a longer period. Moreover, it is suggested that the average subjective exercise intensity of participants may have decreased because they were unable to engage in activities as they would have wished to, compared to July to September 2019, before students were asked to voluntarily restrict their movements. However, activities at exercise clubs, such as sports clubs, resumed from July to September 2020. Also, since exercise intensity tended to be lower in the period from October to December 2020 than from October to December 2019, it is possible that the change in the exercise environment caused by COVID-19 affected students who belonged to athletic clubs after the period when people were asked to voluntarily restrict their movements.

In other words, when people were asked to voluntarily restrict their movements from April to June 2020, activities at sports clubs such as athletic clubs were restricted because of COVID-19, and the degree of subjective fatigue was considered to have decreased as a result of having fewer opportunities to exercise and play sports. From July to September 2020, when people were asked to voluntarily restrict their movements, activities at sports clubs such as athletic clubs were partially resumed, and the degree of subjective fatigue increased with the resumption of exercise and sports activities. Additionally, from October to December 2020, when people were asked to voluntarily restrict their movements, the subjective fatigue level may have increased due to an increase in physical activity as the participants became accustomed to the new style of exercise and sports created by the effects of COVID-19.

The mean subjective fatigue level decreased from April to June 2020, when people were asked to voluntarily restrict their movements, compared to April to December 2019, before this period. On the other hand, the values slightly increased from July to September 2020 and from October–December 2020. However, the result was lower than that between April and December 2019, before people were asked to voluntarily restrict their movements. Although activities resumed between July and September 2020, the subjective levels of reported fatigue were lower than those between April and December 2019. From October to December 2020, the level of subjective fatigue decreased compared with the same time in 2019. The possibility exists that participants were not satisfied with the level of activity they could engage in between July and December 2020.

Likewise, the reasons for the subjective appraisal of fatigue decreasing from April to June 2020, when people were asked to voluntarily restrict their movements compared to April–June 2019, was because there were fewer opportunities to venture outside. Thus, the amount of time spent indoors increased, and opportunities to engage in exercise and sports decreased. This suggests that COVID-19 had a significant impact on physical education students, who normally engage in strenuous exercise in athletic clubs.

Although activities at sports clubs such as athletic clubs resumed in July–September 2020, the subjective level of fatigue decreased compared to the same period of the previous year, indicating that physical tiredness decreased. This may be because the practice of exercise and sports was still prevented from July to September 2020. Some participants resumed activities in sports clubs, engaging in physical activities in the same way as the equivalent period of the previous year. Therefore, their level of physical fatigue was high. Conversely, there was a general tendency for the self-assessment of fatigue to decrease, so there was potential for the practice of exercise and sport to remain hindered.

Conclusions

The purpose of this study was to determine the effects of school closures and curfews associated with the spread of COVID-19 on the lifestyles and physical fitness of physical education students in Japan and their engagement in exercise. We found that school closures caused: 1) a decrease in opportunities to engage in exercise such as club activities, which resulted in a reduced amount of physical activity owing to the difficulty of performing light exercise at home, and 2) a significant change in lifestyle habits such as an increase in time spent

asleep and a decrease in the level of fatigue. In particular, this study investigated how the physical activity, exercise, and lifestyles of Japanese physical education students, who are usually deeply involved in sports, changed due to the school closures and curfews associated with COVID-19.

The present study has several limitations that should be borne in mind when interpreting the results. First, the methodological quality in this study is limited by the quantity and quality of studies available on COVID-19 in the literature. Many studies regarding COVID-19 have significant methodological flaws, such as a small sample size, retrospective evaluation of data, and lack of a control group for comparison. Of course, the sample used for this study was also limited to university students who are actively involved in sports, not ordinary people. Future examinations with greater data should be considered to confirm the findings of this survey and to support the proposed clinical benefit to patients and healthcare providers. Second, the study period was short. In future studies, post-therapeutic data collection, such as vaccine injections, should be performed after treatment.

In the future, it will be important to prevent the spread of infection to maintain and improve health and to maintain sports routines while simultaneously ensuring opportunities to engage in exercise and discover methods that can be used to engage in instruction surrounding exercise. Furthermore, it is necessary to conduct a detailed analysis of the differences in the attributes of the respondents.

Conflicts of interest – There are no conflicts of interest to declare.

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