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Do "Stay-at-Home Exercise" Videos Induce Behavioral Changes in College Students? A Randomized Controlled Trial

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Abstract: The coronavirus disease pandemic has led to college students spending more time at home. "Stay-at-home exercise" videos to mitigate inactivity are currently available on various digital platforms; however, it is unclear whether these videos lead to behavioral changes among college students. This study aimed to investigate the improvement in physical activity (PA) resulting from "stay-at-home exercise" among college students. Overall, 150 college students were recruited, and 125 students (control group: 65; intervention group: 60) who completed baseline surveys were analyzed. The preliminary outcomes were PA, health-related quality of life (HRQoL), subjective well-being (SWB), and psychological stress (K6). Mixed model repeated-measure analysis of variance compared the outcomes before and after the intervention. After 8 weeks of "stay-at-home exercise", there was no significant interaction in PA ($F = 0.02$, $p = 0.89$); however, a significant interaction for the general health subscale of HRQoL ($F = 9.52$), SWB ($F = 6.70$), and K6 ($F = 7.83$) was detected ($p < 0.05$). On comparing the pre- and post-intervention results, we found that only distributing an 8-week streaming video of "stay-at-home exercise" did not increase the amount of physical activity among participants, but it did have a positive effect on their mental health during the pandemic.

Keywords: coronavirus disease (COVID-19); physical activity; college students; mental health; web-based intervention; well-being

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1. Introduction

Physical activity (PA) is defined as any bodily movement produced by the contraction of skeletal muscles. It is an umbrella term that includes subcategories, such as sports, leisure activities, dance, and physical exercise, which is essentially defined as every planned, structured, repetitive, and purposeful intervention [1]. PA plays an important role in preventing and treating non-communicable diseases, which account for 70% of deaths worldwide [2]. The prevalence of inactivity, its global spread, and its impact on health was described by Kahl et al. as a pandemic with major health, economic, environmental, and social implications [3]. The World Health Organization (WHO) recommends that adults engage in at least 150 min of moderate-intensity PA, 75 min of vigorous PA, or an equivalent combination of moderate-intensity and vigorous PA each week [4]. In Japan, in 2013, the guidelines for PA recommended adding 10 min of PA into daily life [5]; subsequently, other measures have similarly been implemented. Unfortunately, according to WHO survey results for 2011–2016, the amount of PA performed daily has not improved in the last 15 years globally [6]. Similarly, this survey reported that less than 30% of adults and 80% of adolescents are physically active [6]. The coronavirus disease (COVID-19) pandemic has become a major challenge for people of all ages (children, adolescents, adults, and the elderly) and people with disabilities due to restrictions on activities, such as going out, resulting in inactivity and adverse health effects [7–10].

On 11 March 2020, the WHO declared COVID-19 a global pandemic; consequently, on 16 April 2020, the Japanese government declared a nationwide state of emergency until May 25 due to the spread of COVID-19 [11]. The Japanese government closed schools, recreational facilities, and commercial establishments and demanded that Japanese people stay at home except for emergencies [11]. In the early stages of the pandemic, university students suffered from sudden school closures, reduced PA, and a significant decline in their psychological health [12,13]. Thus, over the past year, it has become apparent that college students are more susceptible to the health effects of COVID-19.

To overcome this situation, governments and experts are taking measures to alert the population against inactivity with the help of digital platforms by disseminating exercise videos, thereby creating an environment wherein information on health is accessible to all [14]. Particularly, many "stay-at-home exercise" videos have been uploaded to streaming video sites, such as YouTube; undoubtedly, the use of the Internet and related digital platforms, such as websites and smartphone applications, has increased exponentially [15].

A review on PA during the pandemic shows that approaches to improve PA have shown success and equally improved mental health [16]. Moreover, in reviews of interventional studies, digital platform usage was reported to improve PA among individuals of all ages [17–19]. Conversely, it is unclear whether only watching exercise videos on streaming video sites, which have been the most used platform since the pandemic [20], increases PA. In Japan, physical therapists have been uploading "stay-at-home exercise" videos to streaming video sites to ameliorate inactivity. However, to the best of our knowledge, no studies have examined whether distributing exercise videos on streaming video sites is beneficial in improving PA.

In this study, we aimed to determine whether the distribution of "stay-at-home exercise" videos—created by a physical therapist—on a streaming video site for college students, and encouraging them to only watch the video during the lockdown, would be effective in increasing PA and improving health during the lockdown imposed by the COVID-19 pandemic. We hypothesized that during the lockdown for the COVID-19 pandemic, the delivery of the "stay-at-home exercise" videos alone would both increase PA and improve mental health.

2. Materials and Methods

2.1. Participants and Study Design

A priori sample size calculation was performed using G*Power v3.1 [21], and 82 participants were needed to obtain 80% power (α = 0.05, effect size = 0.25) to test the primary outcome. Overall, we recruited 150 students from Hiroshima University, Japan, from 10 January to 20 January 2021. We used the Internet to recruit participants through an online website. The specific inclusion criteria for undergraduate students participating in this study were as follows: (1) students who were at least 20 years old and enrolled in an undergraduate program; (2) the ability to use a computer or smartphone with an internet connection. In contrast, the exclusion criteria were as follows: (1) students with no device to view the "stay-at-home exercise" videos; (2) students incapable of completing all questionnaires.

This study was designed as a randomized controlled trial (RCT). Participants were recruited online and first gave their consent to the study via a Google form. Participants were then randomly assigned to either an "intervention group" or a "control group" by research staff before baseline measurements were completed (single-blind method). Randomization was performed by a computer-generated sequence with an assignment ratio of 1:1. After randomization, participants who completed the baseline questionnaire were granted access to either assigned program; after the 8-week intervention period, participants were emailed to complete a post-intervention questionnaire. Before the study, all participants provided informed consent on the website that was approved by the

Epidemiology Ethics Committee of Hiroshima University (approval ID: E-2250). This RCT was registered at UMIN (UMIN000044868) after trial completion; we followed all the guidelines issued by the Consolidated Standards of Reporting Trials (CONSORT) (Supplementary Materials) [22].

2.2. Intervention

2.2.1. Intervention Group

Participants in the intervention group received a URL to a website to view "stay-at-home exercise" videos created by a physical therapist to increase their daily PA after answering the baseline intervention survey. The "stay-at-home exercise" videos focused on the following three body parts: trunk, upper extremity, and lower extremity; there were seven 5 min videos for each part (Figure 1). At the time of URL distribution, participants were advised to watch the "stay-at-home exercise" video once every day at a time of their choice during the 8-week intervention period. The "stay-at-home exercise" video was uploaded to the website so that the subject could watch it at any time, and the subject was instructed to press the "watch" button on the website to keep a record of their viewing.

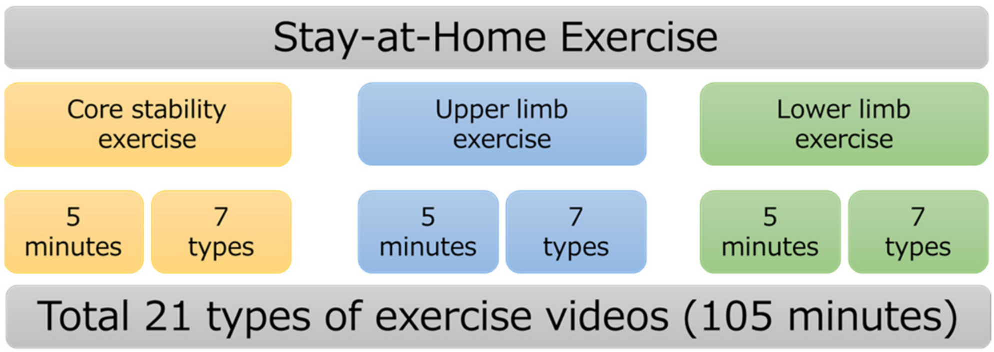

Figure 1. Components of the "stay-at-home exercise".

2.2.2. Control Group

Participants in the control group did not receive a URL after responding to the baseline investigation. No specific instructions were given on how to spend the 8-week intervention period. After completing the 8-week intervention, the participants were asked to complete the questionnaire again.

2.3. Outcome Measures of an Internet-Based Questionnaire

In this study, PA was measured as the primary outcome. Additionally, health-related quality of life (HRQoL), subjective well-being (SWB), and psychological distress were evaluated as the secondary endpoints. This was conducted using an Internet-based questionnaire administered immediately after the assignment to the control and intervention groups (baseline intervention) and the 8-week intervention (follow-up). In the baseline survey, demographic characteristics were similarly examined using an Internet-based questionnaire.

2.4. Demographic Characteristics

At the beginning of the study, all participants completed an Internet-based questionnaire that included demographic information (age, height, weight, body mass index (BMI), and sex), information on whether they belonged to an exercise community, such as a sports club, and had ever watched an exercise video using a digital platform such as YouTube. Additionally, the intervention group received a questionnaire regarding the amount of time spent watching "stay-at-home exercise" videos after the intervention.

2.5. Primary Outcome: PA

To investigate the effect of "stay-at-home exercise" videos on PA, a self-reported, 7-day, short form of the International Physical Activity Questionnaire (IPAQ) was used at baseline and follow-up [23]. The questionnaire comprised nine items to assess the level of PA at moderate intensity (4 metabolic equivalent tasks, METS) and vigorous-intensity (8 METS), during walking (3.3 METS) and sitting. The total PA score was calculated in (MET)-min/week units, which is the sum of each mode of activity multiplied by the constant level of energy (MET) required for the task, as described above, the number of minutes performed per day, and the amount of time for which it was performed per week [24].

2.6. Secondary Outcomes: HRQoL, SWB, and Psychological Distress

The Short Form-8 (SF-8) was used to assess HRQoL at baseline and follow-up. The SF-8 health survey is an 8-item instrument, and each of the 8 items measures a different health dimension: physical function (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), mental health (MH), and role emotional (RE) [25]. Each score was weighted, and two summary scores, the physical component score (PCS) and mental component score (MCS) were calculated. Higher PCS and MCS indicate a better QOL [26]. The reliability and validity of the Japanese version, which was used in this study, have been previously confirmed [27].

The 5-item World Health Organization Well-Being Index (WHO-5) was used to measure the change in SWB from baseline to follow-up. The WHO-5 is one of the most widely used questionnaires for assessing subjective psychological states. Since its first publication in 1998, the WHO-5 has been translated into more than 30 languages and used in research studies globally [28]. Thus, the efficacy of the WHO-5 has been reported in many countries [29]. The items of WHO-5 are as follows: "I have felt cheerful and in good spirits"; "I have felt calm and relaxed"; "I have felt active and vigorous"; "I woke up feeling fresh and rested"; and "My daily life has been filled with things that interest me". The respondent is asked to rate how well each of the five statements applies to them when considering the last 14 days. Each of the five items is scored from 5 (all of the time) to 0 (none of the time). The raw scores range from 0 (worst thinkable well-being) to 25 (best thinkable well-being). The correlation coefficient between the scores in 2016 and 2017 was 0.75, suggesting the stability of the Japanese version of the WHO-5. The stability of the Japanese version was suggested to be good [30].

In this study, the Kessler Screening Scale for Psychological Distress (K6) was measured to assess the change in psychological distress from baseline to follow-up. The K6 consists of six questions assessing depressed mood and anxiety over the past month; each question on the K6 is rated from 0 ("never") to 4 ("always"), with total scores ranging from 0 (no psychological distress) to 24 (severe psychological distress).

2.7. Statistical Analyses

Statistical analyses were performed using SPSS (IBM SPSS Statistics for Windows, Version 27.0. IBM Corp., Armonk, NY, USA). Initially, the Shapiro–Wilk test was used to check the normal distribution. A mixed-model repeated measures (MMRM) analysis of variance (ANOVA) was used to analyze the effect of delivering the "stay-at-home exercise" videos, comparing the mean outcome scores between the intervention and control groups [31]. We assessed the main effect, as well as the group and time interaction, on the outcome measure; MMRM is an intention-to-treat analysis with unbiased estimates that consider all available data from participants enrolled in the trial [31]. An unstructured variance–covariance matrix was assumed. The results of the main estimates were expressed as mean ± standard error of the mean (SEM), and values of $p < 0.05$ were considered statistically significant.

3. Results

3.1. Participants

The flowchart of included participants is shown in Figure 2. Overall, 150 participants demonstrated their interest; however, only 130 were formally enrolled in this study. Of the 130 participants, 65 (50%) were randomly assigned to the intervention group and 65 (50%) to the control group. Five participants in the intervention group were excluded because they did not complete all baseline surveys. Of the 125 participants who completed the baseline survey, 88 responded at follow-up, and the attrition rate at follow-up was 32.3% (*n* = 42, Figure 2).

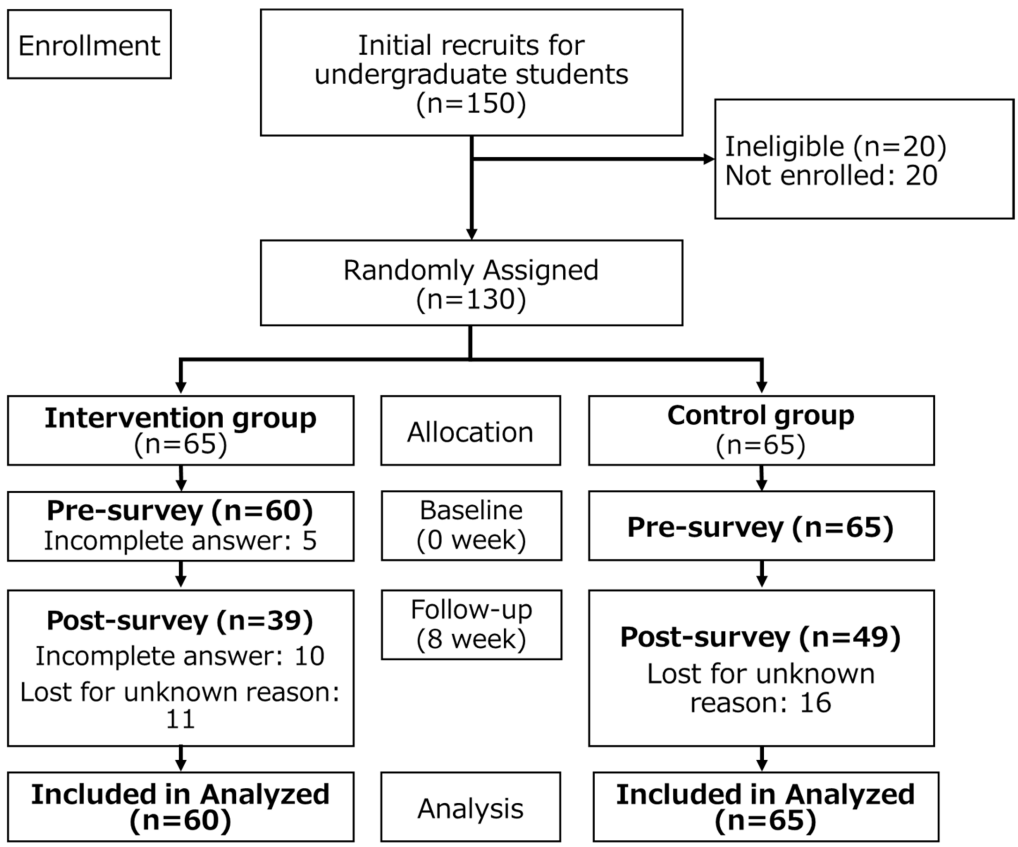

Figure 2. The flowchart of this study following the Consolidated Standards of Reporting Trials (CONSORT) statement.

The demographic and baseline characteristics of the participants and their total sedentary time are shown in Table 1. The mean age of the 125 participants was 21.6 ± 2.9 years. Of these, 57 (45.6%) were male. Fifty-two (41.6%) participants belonged to an active community, and 87 (69.6%) had viewed exercise videos. The most common expected effects of "stay-at-home exercise" content were health promotion (*n* = 52, 41.6%), muscle strengthening (*n* = 36, 28.8%), change in mood (*n* = 25, 20.0%), diet (*n* = 6, 4.8%), and others (*n* = 6, 4.8%). The total sedentary time of the participants was 9.70 ± 2.8 h/day.

In the post-intervention survey, only participants in the intervention group reported the frequency and duration of watching "stay-at-home exercise" videos. Analysis revealed that participants reported watching an average of 27.7 min per week, ranging from 0 to 7 times per week. Of these, 59.0% (every day: six; 4–6 days/week: 10; 2–3 days/week: four; a day/week: four) watched videos at least once a week and for more than 30 min. The remaining 41% (once every 2 weeks: seven; only two times: six; only one time: four) could not watch a video once a week and rarely watched the videos.

Table 1. Participants' demographics and characteristics at baseline.

	Total (*n* = 125)	Intervention (*n* = 60)	Control (*n* = 65)
Age (years), mean ± SD	21.6 ± 2.9	21.6 ± 2.7	21.5 ± 1.4
Height (cm), mean ± SD	164.6 ± 9.8	164.7 ± 8.8	164.5 ± 8.8
Weight (kg), mean ± SD	57.0 ± 11.1	56.5 ± 11.5	57.3 ± 9.9
BMI (kg/m^2), mean ± SD	21.2 ± 2.2	21.0 ± 2.1	21.3 ± 2.3
Sex, *n* (%)			
Male	57 (45.6)	30 (50.0)	27 (41.5)
Female	68 (54.4)	30 (50.0)	38 (58.5)
Belong to an active community, *n* (%)			
Yes	52 (41.6)	23 (38.3)	29 (44.6)
No	73 (58.4)	37 (61.7)	36 (55.4)
Experience watching exercise videos, *n* (%)			
Yes	87 (69.6)	38 (63.3)	49 (75.4)
No	38 (30.4)	22 (33.7)	16 (24.6)
Expected effects of video streaming, *n* (%)			
Health promotion	52 (41.6)	25 (41.7)	27 (41.5)
Muscle strength	36 (28.8)	14 (23.3)	22 (33.9)
Change of mood	25 (20.0)	12 (20.0)	13 (20.0)
Diet	6 (4.8)	4 (6.7)	2 (3.1)
Other	6 (4.8)	5 (6.3)	1 (1.5)
Sedentary time (hour), mean ± SD	9.7 ± 2.8	9.4 ± 2.6	9.9 ± 2.7

BMI: body mass index; SD: standard deviation.

3.2. PA, HRQoL, SWB, and Psychological Distress at Baseline and Follow-Up

Table 2 shows the observed means and SEMs of the outcome variables in the two conditions, and Table 3 shows the estimates of the fixed effects from the MMRM ANOVA model. There was a significant increase in total PA ($F = 10.23$, $p < 0.01$) and a decrease in sedentary time ($F = 8.68$, $p < 0.01$) in both groups at follow-up. Contrastingly, no significant interaction was observed for the total PA and sedentary time ($F = 0.02$, $p = 0.89$; $F = 0.29$, $p = 0.58$). In the SF-8, there was no significant interaction for PCM and MCS ($F = 0.28$, $p = 0.59$; $F = 2.02$, $p = 0.15$); however, there was a significant interaction for the subscale GH ($F = 9.52$, $p < 0.01$). WHO-5 and K6 both showed significant interactions ($F = 6.70$, $p < 0.05$; $F = 7.83$, $p < 0.01$), and SWB and psychological distress in the intervention group were improved by the intervention compared to the control group.

Table 2. Outcome measures at baseline and follow-up (8 weeks).

	Intervention		Control	
	Baseline (*n* = 60)	**Follow-Up (*n* = 39)**	**Baseline (*n* = 65)**	**Follow-Up (*n* = 49)**
IPAQ, mean ± SEM				
Total physical activity (MET-min/week)	1304.4 ± 128.9	1851 ± 162.1	1485.1 ± 173.0	1670.9 ± 163.3
Sedentary time (hour/day)	9.66 ± 0.22	8.82 ± 0.27	8.99 ± 0.29	9.48 ± 0.28
SF-8 (score), mean ± SEM				
PCS	51.9 ± 0.4	53.1 ± 0.5	52.6 ± 0.5	52.4 ± 0.5
MCS	48.6 ± 0.4	49.6 ± 0.6	49.2 ± 0.6	49.0 ± 0.6
General health	53.1 ± 0.4	54.6 ± 0.6	53.8 ± 0.6	53.9 ± 0.6
Physical function	51.9 ± 0.3	52.6 ± 0.4	52.0 ± 0.4	52.5 ± 0.5
Role physical	51.6 ± 0.4	53.1 ± 0.5	52.6 ± 0.5	52.5 ± 0.4
Bodily pain	51.6 ± 0.5	53.2 ± 0.7	53.5 ± 0.7	51.3 ± 0.7
Vitality	54.1 ± 0.3	54.1 ± 0.4	52.9 ± 0.4	53.9 ± 0.4
Social functioning	50.4 ± 0.5	51.8 ± 0.6	51.3 ± 0.6	50.9 ± 0.6
Mental health	49.6 ± 0.4	50.8 ± 0.5	50.5 ± 0.6	49.8 ± 0.5
Role emotional	49.9 ± 0.4	50.7 ± 0.5	50.4 ± 0.5	50.2 ± 0.5
WHO-5 (score), mean ± SEM	15.9 ± 0.4	17.0 ± 0.43	16.4 ± 16.6	16.6 ± 0.4
K6 (score), mean ± SEM	4.7 ± 0.3	3.8 ± 0.3	4.0 ± 0.3	4.5 ± 0.4

Values are expressed as mean ± SEM. IPAQ: International Physical Activity Questionnaire; SF-8: Short Form-8; WHO-5: World Health Organization-5 well-being index; K6: Kessler psychological distress scale-6.

Table 3. Estimates of fixed effects from mixed model repeated-measure models.

Outcome and Source	Intercept		Time		Group		Interactive Effect (Time × Group)	
	F test	*p* Value	*F* test	*p* Value	*F* test	*p* Value	*F* test	*p* Value *
IPAQ								
Total physical activity	1932.53	<0.001	10.23	0.002	0.61	0.432	0.02	0.891
Sedentary time	2059.69	<0.001	8.68	0.004	1.42	0.235	0.29	0.586
SF-8								
PCS	18,834.15	<0.001	4.15	0.043	0.07	0.782	0.28	0.596
MCS	12,228.78	<0.001	2.38	0.125	0.03	0.855	2.02	0.157
General health	13,517.86	<0.001	5.33	0.023	<0.001	0.988	9.52	**0.003**
Physical function	29,077.31	<0.001	1.83	0.179	0.86	0.353	0.71	0.403
Role physical	21,454.89	<0.001	3.48	0.064	3.48	0.064	0.22	0.638
Bodily pain	9370.03	<0.001	4.61	0.034	4.35	0.038	0.23	0.626
Vitality	24,718.25	<0.001	8.18	0.005	2.13	0.146	2.97	0.087
Social functioning	12,454.57	<0.001	3.87	0.051	0.17	0.679	0.92	0.337
Mental health	13,645.09	<0.001	3.88	0.051	0.71	0.398	0.90	0.342
Role emotional	15,365.89	<0.001	1.56	0.212	0.04	0.829	2.06	0.153
WHO-5	24,497.38	<0.001	6.18	0.010	0.11	0.730	6.70	**0.010**
K6	24,902.61	<0.001	7.21	0.008	0.84	0.360	7.83	**0.006**

Values are expressed as mean ± SEM. IPAQ: International Physical Activity Questionnaire; WHO-5: World Health Organization-5 well-being index; K6: Kessler psychological distress scale-6; CI: confidence interval. * *p* values < 0.05 are considered significant (indicated with **emboldened** font in Interactive effect).

4. Discussion

This is the first study to investigate whether only distributing "stay-at-home exercise" videos on a streaming video site to college students during a pandemic and encouraging them to only watch the videos—i.e., not directly instructing or guiding them to do the exercises—would result in changes in PA. The study results showed that the distribution of "stay-at-home exercise" videos did not significantly improve the PA of college students; however, it did improve their mental health, including HRQoL, SWB, and psychological distress.

4.1. Relationship between Video Streaming and Physical Activity

The imposition of lockdown due to the COVID-19 pandemic may have increased the interest and involvement in PA in the population [32]. During the same period, the use of the Internet and related digital platforms, such as websites and smartphone apps, increased exponentially [15]. Web-based interventions, which were becoming more prevalent in these situations, are present in even greater demand. Studies conducted during the COVID-19 pandemic have shown that the amount of PA performed differs according to the use of a digital platform; additionally, they demonstrated that web-based interventions are effective for PA in today's behaviorally restricted environment [20]. Even before the COVID-19 pandemic, people who used digital platforms reportedly had a higher level of PA than those who did not [33,34].

However, in our results, there was no significant change in PA with or without the distribution of exercise videos, which is different from the results of conventional web-based interventions. The reason for this is that our interventional methods are different from the traditional web-based interventions. Traditional interventions, such as web-based, face-to-face exercise instruction and eHealth-based health management, are interventions that directly change the behavior of the target population [35,36]. An interesting finding of a previous study is that students who received both motivational interviewing and web-based interventions reported the most benefit from walking [37]. Our intervention, contrastingly, was quite simple; we only delivered a "stay-at-home exercise" video and did not force the participants to exercise.

The study results showed that 59% of the participants watched more than 30 min of the video per week. However, the remaining 41% could not watch a video even once a week. Some of the subjects watched the video only once during the intervention period. Considering these results, it is clear that delivering videos alone is insufficient to change

PA; both the delivery method and the content need to be improved to effect a change in PA. Currently, many people are distributing exercise videos on digital platforms, but distribution alone has not been shown to have a significant impact on college students' PA, and it was thought that compulsion to participate in exercise might be necessary to improve PA.

In terms of mental health, the content delivery group showed significant improvements in SWB, psychological distress, and GH. Data from the US show that during a pandemic, approximately 90% of college students are concerned about adverse health effects, and nearly half experience mental health problems [12]. The same phenomenon has been observed among Japanese college students [38]. In response to this, several studies have reported on mental health interventions; web-based mental health interventions are reportedly effective for college students whose classes are online and whose opportunities for face-to-face interaction have drastically reduced [39–41]. Health literacy is defined as "the extent to which an individual can obtain, process, understand, and communicate health-related information needed to make informed health decisions" [42]. Researchers agree on the importance of health literacy and believe that people with low health literacy are at a higher risk for several adverse health outcomes [43–45]. In this study, we delivered information on exercises, such as "stay-at-home exercise", and this intervention led to increased knowledge about exercise. We believe that the participants in the intervention group must have anticipated that the videos would improve their physical health, which may have contributed to the improvement in their mental status.

The strength of this study is that the intervention of merely distributing exercise videos had an impact on improving the mental health of college students. Based on the study results, future research on the methods of distribution of exercise videos to improve PA and their content (e.g., including content that enhances health literacy) will help solve the health problems of college students during the pandemic.

4.2. Limitations

First, we observed that PA improved from baseline to follow-up in both the intervention and control groups. This may be because the baseline survey period coincided with the behavioral restriction period caused by the COVID-19 pandemic, and the behavioral restriction period had been lifted at the time of follow-up. Therefore, we cannot exclude the possibility that PA was affected by factors other than the intervention. Second, the results did not fully consider the Hawthorne effect (a type of reactivity wherein individuals modify an aspect of their behavior in response to their awareness of being observed); as it may have contributed to the improvement of mental health in the intervention group, it is necessary to consider this effect in future designs. Third, all survey items were self-reported, and recall bias cannot be excluded. Finally, 32.3% of the subjects dropped out during the intervention period, and the continuation rate was low. This could be because the second response period coincided with the long vacation at the end of the school year, and many students lost contact with us due to relocation or other reasons. In the future, it will be necessary to build a system that automatically checks if the subject has watched the video and automatically and accurately counts the number of videos. Additionally, we would like to build a follow-up system to ensure that no one drops out.

5. Conclusions

We found that only distributing and encouraging the viewing of the "stay-at-home exercise" videos neither resulted in college students exercising nor increased their PA, but that it significantly improved their mental health. In other words, simply distributing exercise videos on a digital platform did not increase activity; additional efforts should be made to encourage exercise. The results of this study will provide useful suggestions for approaching the health problems among college students that are becoming apparent during this COVID-19 pandemic.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132111600/s1.

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Institutional Review Board Statement: The study protocol met the requirements of the Declaration of Helsinki and was approved by the Ethical Committee for Epidemiology of Hiroshima University (approval ID: E-2250).

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