Effects of an exercise program with video: targeting older female residents in a remote island

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Abstract. [Purpose] This study aimed to consider the influence of a three-month video exercise program on the physical function of older females. [Participants and Methods] Nineteen older females (aged 72.9 ± 3.64 years) participated in this study. We formed two groups—an experimental group that exercised (n=9) and a control group that did not exercise (n=10). Our study’s exercise program focused on leg training. We conducted physical and cognitive tests before and after the program to determine the effects of the exercise program. [Results] The results of the second physical (post-intervention) test showed that the exercise group recorded significant improvement in the one-leg balance test with eyes open. However, no improvement was observed in cognitive function. [Conclusion] The static balance capacity of the exercise group improved. Thus, the three-month video exercise practice was effective for physical function improvement.

Key words: Senior residents of a remote island, Video exercise program, Effects of exercise

INTRODUCTION

In Japan, where aging has been progressing quickly, the health issues of senior residents, including escalating health care costs, are taken seriously.1, 2 In recent years, local governments all over the country have organized classes focusing on preventive measures for declining health, and the effects of these initiatives are increasingly being reported on.3, 4 The setting for this particular study is Nakajima, a remote island off the coast of Matsuyama city. Nakajima has a population of 3,512 people and 67.1% of the population is over the age of 65. Although the proportion of older adults in Nakajima is very high, local government services do not easily reach elderly residents due to the inconvenience of traffic. Furthermore, this island has witnessed a reduction in community activities and the proportion of older adults who are homebound is high. As the restrictive life continues due to the spreading of COVID-19, it is thought that people’s physical activity has significantly decreased, especially among the elderly. Therefore, remote exercise instruction, using information and communication technology (ICT), has grown in popularity. However, it is difficult for many senior citizens to use ICT and participate in remote exercise activities. Preceding research on non-face-to-face exercise instruction for senior residents has been conducted using a variety of methods, for example, it has looked at intervention through “tele-fitness” among the regional community, with assistance from support staff in using ICT.5 Other research examined the practicality of exercise instruction using home gymnastic robots.6 Further, photographs with text descriptions were used in home exercise for elderly people with knee pain.7 While the research mentioned above examined practicality, in the numerical value of the physical strength in intervention order, an evaluation was not carried out. While preceding studies have performed exercise intervention without DVD using. It is the apparatus that it is easy to treat the DVD for elderly people. It is easy to perform home exercise by DVD, looking at an image, since it is moving image. Rather than focusing on a program with exercise instruction, in this study, an exercise intervention in video form was implemented. The purpose of this research was to verify the influence a video exercise program has on the physical function of the senior residents of a remote island.
PARTICIPANTS AND METHODS

A total of 19 females (aged 72.9 ± 3.64 years) participated in this study. Two groups were formed: an experimental group that exercised (n=9) and a control group that did not exercise (n=10). A research briefing session was conducted to the salon members on the remote island, and participants were recruited. They were allowed to select which group to be in. The exclusion criteria for the study restricted the following from participating: 1) individuals who have not live independent, 2) individuals with impaired comprehension and a score of 20 or lower on the Revised Hasegawa Dementia Scale, a cognitive function test; and 3) individuals who did not consent to partake. All the qualifying participants provided written informed consent before starting the study protocol, in accordance with the Declaration of Helsinki, and the study was approved by the Tokaiakuen University Ethics Committee (2020-3). The research period was from June–October of 2018. Exercise content was developed into video format; a DVD was produced and distributed to the exercise group, along with an exercise log. The exercise program comprised the following four exercises: (1) an exercise of the head using the hands (about 1 minute long); (2) a warm-up exercise focusing on stretching (approximately 3 minutes); (3) leg muscle and bodyweight training comprised of four exercises (1. leg extension, knee ups, fsquats, and calf raise—each ten repetitions); and (4) Matsuyama gymnastic exercise for preventative care (approximately 3 minutes and 30 seconds). The total time of the exercise program was approximately 15 minutes. Before and after the exercise intervention, the following physical fitness activities were measured: two grip strength measurements on each of the hands (the mean value of the stronger hand was used, using a digital grip strength dynamometer Takei Digital Grip Strength Dynamometer Model TKK5401, Japan); a 10-m obstacle walking test (measured twice, with the faster measurement being recorded—the obstacle was 100 cm in width, 20 cm in height, and with a depth of 10 cm, the product was made from styrene foam—from the start point to the end of the obstacle course, a total of six obstacles were placed with 2-m intervals); one-leg standing with eyes open (measured twice, with the longer measurement being recorded, the maximum value for the measurement was 120 seconds. As I did not specify which should be weight-bearing leg, the weight-bearing leg was selected by each participant). The cognitive function measurement items were cerebral blood flow activation during the task and a Yamaguchi Kanji Symbol Substitution Test (hereafter YKSST). To measure the cerebral blood flow during cognitive activity, the INVOS 5100C (Covidien company, Japan) was used, which is a brain oximeter that measures regional saturation of oxygen (rSO2) of brain tissue using near infrared spectroscopy. rSO2 is measured by sticking an NIRS sensor on the right and left temples. rSO2 expresses the oxidization Hb in all the Hb with %. INVOS 5100C can monitor rSO2 continuously by no invading. Moreover, INVOS 5100C can acquire the circulation dynamic state information on required parts, such as the brain. The cerebral blood flow of the participants was measured in a seated position. Participants were asked to solve problems using mental arithmetic without speaking about the easy addition and subtraction. The measurements were taken 20 seconds, 40 seconds, and 60 seconds after the cognitive exercise. The other cognitive function test YKSST is a test of the combination of a Chinese character and a sign. In the test, questions must be answered as exactly as possible within 120 seconds9). Data are communicated as mean ± SD, and in this instance, paired t-tests were used to compare the groups’ physical tests and cerebral blood flow measurements to judge the effects of the exercise intervention. Additionally, unpaired t-tests were used to compare the groups’ physical tests before and after the exercise intervention. A two-way ANOVA was used to compare the difference of the average value of the rSO2, a Wilcoxon signed-rank test was used to compare the groups’ YKSST measurements to judge the effects of the exercise intervention, and a Mann-Whitney U test was used to compare the groups’ YKSST measurements before and after the intervention. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 21. Statistical significance was set at p value <0.05.

RESULTS

The averages of the exercise group’s height and weight were 150.9 ± 3.1 cm and 53.1 ± 5.9 kg. For the non-exercise group, they were 150.6 ± 3.6 cm and 50.1 ± 8.4 kg. The participants’ exercise frequency in one week before the research start was as follows. In the exercise group there was one participant exercising five days or more (11.1%), two participants three to four days (22.2%), two participants one to two days (22.2%), and four participants not at all (44.4%). Out of the non-exercise group, one participant exercised five days or more (10.0%), two participants four days (20.0%), and two participants one to two days (20.0%), and have not acted five participants (50.0%). There was almost no difference of the prior exercise frequency of exercise group and non-exercise group. As recorded in the exercise log, an average of exercise adherence for the three months of video workouts was 78.0% among the exercise group. The participant with the highest exercise adherence showed a rate of 98.9%. In all the pre-measurement items, there was no statistically significant difference in the result of exercise group and non-exercise group. The results of the physical fitness test before and after the exercise interventions are shown in Table 1. A statistically significant change regarding the one-leg standing with eyes open test was found in the exercise group (p<0.01). As for the cognitive tests, the rSO2 value, measured at the time of quiet and mental arithmetic, showed no statistically significant change from before to after the intervention. The results of the YKSST measurements before and after the exercise intervention are shown in Table 2; no statistically significant change was found there either.
In this study we offered a video exercise program to female senior residents of a remote island. We aimed to comprehend the influence practicing exercise via video for three months would have on physical function of those who cannot easily access public and communal exercise classes. In the exercise group, balance improved after three months of intervention, as they regularly performed muscle training focusing on the legs. Although there was a considerable amount of leg exercise in the intervention, it was not sufficient for an improvement in walking ability, including dynamic balance. Previous research showed that before and after the intervention of home exercise for six months—with a frequency of 3 times per week—for the 23 local, independently living subjects, the average length of the one-leg standing with eyes open exercise improved significantly from 25.8 ± 18.2 seconds to 34.1 ± 21.2 seconds. In other previous studies, a significant change was identified in ankle control balance training when the frequency two times per week intervention of four weeks. In the same study, the average statistics of the one-leg standing with eyes open exercise went from 29.1 ± 6.7 seconds to 39.6 ± 11.1 for 27 of the residents. Although preceding research differed in the length of the intervention period, the average value of the one-leg standing with eyes open exercise in this study showed a high numerical value before the intervention, and the effects of the intervention was also larger than the findings of previous research. While the results showed that the exercise program did not affect the change of cerebral blood flow, it was considered that the evaluation item at the time of measurement are related that change was not shown in a cerebral blood flow. In previous studies, it can be seen that for older subjects, it was after following the simple arithmetic and reading intervention for two months that the results of the cerebral-blood-flow measurement by NIRS under stroop test execution improved. The stroop test reflects the control function. The control function is got at late time of the development, and it is supposed that it is sensitive to an effect of the intervention. On the other hand, the simple mental arithmetic is got at considerably early time of the development, and it is believed to have influenced the result, showing that it was not sensitive to the effects of the intervention. The average value of YKSST was stable. The index of the improvement in YKSST is shown in three months if score of three or more. Although participants were improving by three or more score, as there was variation in score, there was no significant difference in the statistics.

It has been reported that the standard value of rSO2 is 60–80%\(^{12}\). The participant’s results were within this standard range. The 3-month video home exercise program did not result in rSO2 improvements, but physical improvements were identified. The results of this study could be useful in remote island environments where face-to-face instruction cannot be received. The limitations can be found in the insufficient exercise time. Therefore, future research may conduct the intervention study for a longer period. An explanation of the research results and exercise instructions were also communicated to the non-exercise group after the completion of the study, and the exercise-DVD was distributed. While it is expected that the present restrictive lifestyle will continue, the exercise practice DVD is believed to be able to help maintain the physical strength of the elderly.

Future research theme is being the same contents of exercise in meeting, performing the same period, and comparing with the result of this research to the advanced age woman of residents.

**Conflict of interest**

None.

**Table 1.** Effect of physical fitness

|                    | Exercise group | Non-exercise group |
|--------------------|----------------|-------------------|
| PRE                | POST           | PRE              | POST |
| Grip strength (kg) | 22.6 ± 2.8     | 23.0 ± 2.4        | 20.8 ± 2.5 | 20.5 ± 2.4 |
| 10-m obstacle walking test (sec) | 7.9 ± 1.3     | 7.7 ± 0.7        | 8.7 ± 1.1 | 8.5 ± 1.5 |
| One-leg standing with eyes open (sec) | 40.3 ± 40.1 | 60.0 ± 37.3** | 45.7 ± 51.1 | 40.3 ± 42.8 |

**p<0.01.

**Table 2.** Change of YKSST values

|                    | Exercise group | Non-exercise group |
|--------------------|----------------|-------------------|
| PRE                | POST           | PRE              | POST |
| 44.9 ± 13.6        | 49.7 ± 9.3     | 36.1 ± 16.1       | 43.3 ± 7.3 |
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