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Original Article

The Effects of Floor-seated Exercise Program on Physical Fitness, Depression, and Sleep in Older Adults: A Cluster Randomized Controlled Trial

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SUMMARY

Background: Older adults with deteriorating health and limited activity levels spend most of their leisure time sitting on the floor; this indicates the need for preventive programs to increase the accessibility of exercise. We developed a floor-seated exercise program (FSEP) for them and examined its effect.

Methods: A randomized comparison of pre-and post-test design was used with 77 participants assigned to either an exercise group (n = 39 in three clusters) or control group (n = 38 in three clusters) in six senior community centers. The final sample included 33 participants who completed the FSEP for 12 weeks, and 30 control participants. The exercise group participated in the FSEP four days a week; they were provided direct and videotaped instruction respectively for two days each by a peer volunteer at the senior community center to which the participants' belonged.

Results: Adjusted analysis revealed that the 12-week FSEP was significantly effective in enhancing muscle strength ($p < 0.005$) and shoulder flexibility ($p = 0.001$), except in the non-dominant side wrist muscle strength and shoulder flexibility. Further, it reduced depression ($p = 0.001$), but had no significant effect on sleep quality ($p = 0.087$).

Conclusion: FSEP should be adopted as a health promotion program at senior community centers for South Korean older adults.

1. Introduction

Owing to decreases in physical and cognitive functions caused by chronic diseases and aging, the proportion of the elderly population having difficulties in performing daily activities of living (ADL) independently is also increasing. Sleep disturbances and depression are major public health problems in older adults[1]. Their sleep disturbances are attributed to sedentary lifestyles and lack of physical activities that could result in fatigue, depression, greater anxiety, and irritability[2,3]. Older adults tend to use pharmacological treatments to relieve common symptoms such as sleep disturbance and depression. However, pharmacological treatments of sleep disturbance and depression in older adults are related to hazardous side effects[2,4].

A current systematic review synthesized the evidence that meditative movement interventions, such as Tai-chi, Yoga, and Qigong, may benefit older adults with sleep problems[5]. Meditative movement interventions take advantage of the interactions among the body, mind, and behavior to maintain and improve physical function and health. Exercise is commonly considered a planned and recurring subset of physical activity that results in physical fitness[6].

Senior community centers comprise 95.1% of leisure and welfare facilities for older adults in South Korea[7]. They are mostly used by older adults with deteriorating health and limited activity levels, and provide spaces for leisure where 10–20 older adults can spend their time on the floor. These spaces are, however, not suitable for older adults to stand up and exercise. Considering that one of key cultural habits of Korean elderly, is to spend most of their time sitting on the floor rather than on chairs, the accessibility of exercise can be increased if a floor-seated exercise program (FSEP), in which an exercise is done sitting on the floor, that fits their life style

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is developed and utilized. Older adults with weak lower limb strength have to push the floor or wall with their palms to get up from the floor, so the exercise program should include movements that strengthen not only the lower limb but also the upper limb muscles. In addition, it is necessary to distribute the FSEP as a group exercise by making FSEP videos and train peer volunteers to increase adherence to the exercise.

This study developed a FSEP suited for older adults with reduced physical strength, within the spatial constraints of senior community centers, and trained them for 12 weeks. Further, we aimed to determine its effect on improvements in physical strength and quality of sleep and reduction in depression.

2. Materials and methods

2.1. Sample and recruitment

This study adopted a cluster randomized controlled trial and a pre-posttest design to test the effectiveness of a FSEP for older adults, which was conducted between July and October 2016. Six senior community centers in the city of Siheung in South Korea, with sufficient floor space for 10 or more people to exercise and participate in the FSEP, were selected. Six senior community centers were randomly assigned to either the exercise or control group using RANDBETWEEN statement of Microsoft Excel 2010. Participants' eligibility criteria were as follows: a) aged ≥65 years, b) able to sit for 40 min independently without an assistive device, c) scored 19 or higher on the Mini-Mental State Examination-Korean version (MMSE-K)[8], d) absence of any unstable physical condition, evidence of terminal illness, or history of abusive behavior, e) completion of the consent form, and f) did not have a regular exercise routine.

The sample size of the two groups was calculated based on sleep quality data from a previous study[9,10]. For a sufficient statistical power of 0.80, an effect size of 0.80, with a significance level of 0.05, a minimum 52 participants were required for a two-sided two-sample *t*-test, as per Cohen's power analysis[11]. Assuming an intra-cluster correlation coefficient (ICC) of 0.049 (derived from a community-based intervention study[12]), 6 clusters with an average cluster size of 12, and we estimated a design effect of 1.539[13]. Thus, the sample size was required 47. Allowing for up to 30% loss to follow-up, 39 and 38 participants were recruited for the exercise and control group respectively from the six randomly selected senior community centers. The final sample included 33 (84.6%) and 30 (78.9%) participants in the exercise and control group respectively (Fig. 1). This study was approved by the institutional review board (IRB approval number: MC16QISI0072). Written informed consent was obtained from each participant.

2.2. Measurements

To ensure the accuracy and consistency of measurements, two nurses with at least three years of experience were appointed as research assistants; they were trained in how to measure the variables and take precautions prior to the study. Demographic information was collected using a self-report questionnaire. Dependent variables were evaluated at baseline and after 12-week intervention after blinding the information of both the groups.

The primary outcome measure was sleep quality that was evaluated using the Korean version of the Pittsburgh sleep quality index (PSQI-K)[14]. The total PSQI-K scores range from 0 to 21 points, with a “good” or “poor” sleeper determined with reference to 8.5 points, and higher scores representing poor quality of sleep. Cronbach's alpha was 0.70 in the present study.

The secondary outcome included physical fitness and depression. The percentage of muscle to body weight was calculated by bioelectrical impedance analysis (Inbody H20, Biospace, Seoul, South Korea). Shoulder flexibility, grip strength, elbow, and wrist joint muscle strength were assessed to measure physical fitness. The back scratch test measured the distance between the middle fingers of both hands, while the dominant arm was lowered from the front to back of the shoulder and the non-dominant arm was raised from the waist to shoulder as far as possible. The shoulder flexibility of the non-dominant arm was measured using the same method. The back scratch test was conducted twice and the mean value was recorded. Grip strength was measured twice for each hand with an electronic hand dynamometer EH101 (Camry, Guangdong, China), and the mean value was recorded[15]. A Nicholas manual muscle tester (Model No. 01163, Lafayette instrument company, IN, USA) was used to measure muscle strength of both shoulders, elbows, and wrists based on the developer's guideline. Each participant performed lying supine with the elbow at 90° of flexion and the forearm in neutral supination. The participants were to exert maximal force and continue exerting during a four-to 5-s period[16]. The examiner held the hand-held dynamometer stationary while the subject exerted maximal force against it[17]. Two measurements were taken at one to 2 min intervals, and the average value was recorded in kilograms[13]. The interrater coefficient of the pre-test for five subjects was r = 0.90–0.96.

Depression level evaluated using the Geriatric Depression Scale Short Form-Korean version (GDSSF-K)[18]. The GDSSF-K is composed of 15 items with the score ranging from 0 to 15 and a cut-off score of 5; higher scores indicate a greater the degree of depression. Cronbach's alpha was 0.83 in the present study.

2.3. Intervention

The FSEP is based on the “sitting yoga program” for wheelchair-seated nursing home residents[19]. The program was modified to fit older adults in senior community centers based on consultation with one exercise specialist, yoga instructor, and nursing professor experienced in developing an exercise program for older adults. In addition, a video of the FSEP was produced so that older adults could gather at the senior community center at a time convenient to them and easily follow the exercise.

Peer volunteers were trained for 50 min on the method for checking the health status of the participants before and after the program, the coping method when a side effect occurs, and how to play the video; their understanding was verified after the training. The exercise group participated in the FSEP twice a week by direct instruction and twice a week by a peer-volunteer-led videotaped program. When the peer volunteer was leading the FSEP using the videotape, the investigator also participated in the program for the first eight sessions (four weeks) to ensure that the participants were familiar with the exercise method using the videotape for their safety.

The exercise group attended 30–40 min sessions of the FSEP four times weekly for 12 weeks, according to the ACSM guidelines[20], while the control group received the usual care without any knowledge of the exercise. The FSEP consisted of warm-up and cool-down routines rated 8–9 on the Rated Perceived Exertion (RPE) scale[21] assessing exercise intensity, conducted 5 min before and after the main exercise. The goals of the main exercise were to improve grip strength, upper limb muscle strength, and shoulder flexibility through gradual, repetitive movements, and to increase the exercise intensity to 10–14 on the RPE. The main exercise focused on stretching, strengthening, coordination, breathing, and relaxation techniques for 20–30 min (Fig. 2). After the completion

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