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Original Article

Intervention study of finger-movement exercises and finger weight-lift training for improvement of handgrip strength among the very elderly

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ABSTRACT

Objectives: To examine the effects of finger-movement exercises and finger weight-lift training on handgrip strength and Activities of Daily Living Scale (ADLS) values.

Methods: A total of 80 very elderly adults (aged ≥ 80 years) were assigned to either an intervention group ($n = 40$) or a control group ($n = 40$). Subjects in the intervention group performed finger-movement exercises and weight-lift training for a period of 3 months, while subjects in the control group received no intervention, and were unaware of the interventions received in the other group.

Results: After completing 3 months of finger-movement exercises and weight-lift training, the average handgrip strength of the 40 participants in the intervention group had increased by 2.1 kg, whereas that in the control group decreased by 0.27 kg ($P < 0.05$). After receiving intervention, the number of subjects in the intervention group with an ADLS score > 22 points decreased by 7.5% ($P < 0.05$, vs. pre-intervention).

Conclusions: The combined use intervention with finger-movement exercises and proper finger weight-lift training improved the handgrip strength and ADLS values of very elderly individuals. These rehabilitation exercises may be used to help the elderly maintain their self-care abilities.

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1. Introduction

As a greater proportion of the population reaches an advanced age, methods than can assist in healthy aging have

become more important than ever. One of the endpoints used to assess healthy aging is the ability maintain self-care abilities for as long as possible. Handgrip strength is commonly used as a surrogate measurement of overall muscle strength,

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and among elderly individuals, handgrip strength is associated with health-related quality of life [1], the ability to perform activities of daily living (ADLs) [2], bone mineral density and the incidence of vertebral fracture [3], length of hospitalization [4], psychological and social health [5], and the development and prognosis of certain diseases [6–8]. Additionally, handgrip strength is useful for assessing the general health of older adults, and predicting both disability [8] and mortality [9]. For example, results of a 9.5-year observational study of 555 adults aged >85 years showed that handgrip strength was a predictor of mortality from all causes in the very elderly [10].

Handgrip strength declines with age, and especially among individuals aged >80 years. A study of 8342 Danes aged 46–102 years, showed linear declines in handgrip strength with age between 46 and 85 years, and rapid declines after 85 years [11]. The handgrip strength of individuals aged 80–89 years is 37% less than that of individuals aged 30 years [12], and declines with average losses of 1.53 kg/year among men and 0.85 kg/year among women aged 85–89 years [10]. Handgrip strength is an important factor which impacts an elderly individual's ability to perform ADLs, which typically require a maximum handgrip strength ≥ 9 kg [2].

While various interventions for improving muscle strength have been reported, almost no information has been reported on such interventions in very elderly individuals (aged ≥ 80 years). However, some studies have suggested that exercise during later life improves muscle strength and physical function [13], and that older adults who are physically active can regain some amount lost strength as they age [14]. Skilled finger-movement training can be used to improve an individual's ability to control submaximal pinch force and hand function [15]. Another study indicated that higher levels of physical activity can improve grip strength in older adults, and emphasized that greater attention must be given to designing interventions which may improve grip strength [16].

Finger-movement exercises are traditionally used during the rehabilitation of hand functions, and interventions based on finger-movement exercises and finger weight-lift training have been accepted by older adults in Hanzhou. We conducted our current study to evaluate the effects of finger-movement exercises and finger weight-lift training on the self-care abilities of very elderly subjects (aged ≥ 80 years). We used our finger exercise and weight-lift baseline data to determine the long-term effects of these exercise methods on improving handgrip strength.

2. Methods

2.1. Research design

This was an experimental study which enrolled subjects aged ≥ 80 years (range, 80–93 years). Participants in the intervention group performed finger-movement exercises combined with finger weight-lift training for a period of 3 months. Participants in the control group were recruited from a different social welfare institution than participants in the intervention group. Control group subjects did not receive intervention, and were not aware of the intervention group. The study was

approved by the ethics committee for the School of Nursing, Hangzhou Normal University.

2.2. Sampling and sample size

Subjects enrolled in the intervention and control groups were recruited from Hangzhou No. 2 Social Welfare Courtyard and Hangzhou Social Welfare Center, respectively. The inclusion criteria for this study were: (1) age ≥ 80 years, (2) conscious and able to communicate in Chinese, (3) no upper-limb defects and able to undergo handgrip strength measurements, (4) no contraindication for hand exercise, (5) no disease that would restrict the application of hand force, and (6) ability to remain in a sitting position while performing finger exercises and weight-lift training. The exclusion criteria were: (1) cardiac function rating of \geq class III, (2) severe cognitive impairment, (3) upper limb pain, severe arthritis, or nervous or cardiovascular disease that prohibited performance of handgrip measurements or exercise, and (4) any other condition that restricted the application of hand force.

The statistical power and effect size in this study were determined using SPSS for Windows, Version 16.0. Chicago, IL: SPSS Inc. The initial measurements of handgrip strength of study participants were taken at the welfare institutions prior to the start of intervention, and the results showed a standard deviation (SD) and permissible error of 4.5 and 0.15, respectively. P -values < 0.05 were considered statistically significant. Based on the t -test sample size calculator developed by Gao [17], the estimated required sample size for this study was 29 individuals. Assuming an attrition rate of 10% in the repeated-measures studies, we selected a sample size of 40 subjects for each group.

2.3. Intervention

Study participants in the control group received no intervention. The 40 participants in the intervention group were assigned to one of four subgroups, and each subgroup selected a leader. The leader gathered the participants into the exercise room every morning at 10 a.m. with the assistance of the caregiver, and then led the participants in the exercises. The exercises were conducted daily, and consisted of 20 min of finger-movement exercises and 10 min of finger weight-lift training. When the exercises were completed, the leader of each group recorded the performance of each participant, including how long the participant performed the exercises, whether or not the exercises were completed, and how the participant felt about the physical effects at the end of the exercises. The study investigators joined the exercise groups every Monday, Wednesday, and Friday, and student nurse volunteers joined on weekends.

To help ensure compliance of the participants with the exercise program, the investigators inspected the performance record of each participant in the intervention group every weekend, measured handgrip strength every month, and presented gifts to group members to encourage their participation. To avoid the influence of weather, the exercises were conducted between September and November, when the weather was relatively mild and stable.

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